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AN EVALUATION OF COAL CLEANING PROCESSES AND TECHNIQUES FOR REMOVING PYRITIC SULFUR FROM FINE COAL

A Report by
Bituminous Coal Research, Inc.

to Division of Process Control Engineering
National Air Pollution Control Administration
Consumer Protection and Environmental Health Service
Public Health Service
U.S. Department of Health, Education and Welfare

Contract No. PH-86-67-139

BCR

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BITUMINOUS COAL RESEARCH, INC.
SPONSORED RESEARCH PROGRAM

AN EVALUATION OF COAL CLEANING PROCESSES AND TECHNIQUES FOR REMOVING PYRITIC SULFUR FROM FINE COAL

Interim Report
(BCR Report L-339)
September, 1969

I. Introduction

A. Background

During the combustion of fossil fuels, sulfur oxide compounds are formed and released to the atmosphere. If it were feasible to physically remove pyrite from coal in significant quantities, the amount of sulfur oxide produced from coal firing could be reduced.

Late in 1964 Paul Weir Company undertook an investigation on the feasibility of reducing the sulfur content of coals by generally known coal preparation methods. The work, sponsored by NAPCA, was accomplished under contract No. PH 86-65-29 and the final report was submitted in October 1965. A supplemental study was also undertaken by the Paul Weir Company on the feasibility of recovering sulfur and iron from coal pyrites. The supplemental report was submitted to NAPCA in May 1966.

The reports were encouraging and assisted in outlining areas where additional data or evaluation was required.

One area where little information existed was on the washability of coals that were mined primarily for use in power generation. To eliminate this deficiency, contracts were awarded to the United States Bureau of Mines, the Illinois Geological Survey, and Commercial Testing and Engineering Company to develop washability data on these seams.

The washability studies were rather unique in that they were to develop information on pyrite liberation at various stages of crushing and grinding rather than developing washability data on the various sized fractions as mined so that the proper sized splits could be made and the proper cleaning equipment and separating gravity selected.

BCR's interest in sulfur reduction in steam coals by coal cleaning dates back to 1956, when a study was undertaken at the request of the informal Working Committee on Air Pollution Subjects of Interest to Electric Utility and Coal Industries. This study was summarized in a report written by Dr. H. J. Rose and Dr. R. A. Glenn, dated March 8, 1957, and entitled "Coal Cleaning in Relation to Sulfur Reduction in Steam Coal." (ASME paper No. 58A147).

Subsequent work led to the BCR concept of pyrite removal at the utility pulverizer. Details of this work are contained in a paper prepared by R. A. Glenn and R. D. Harris, entitled, "Liberation of Pyrite from Steam Coals" and presented at the 54th Annual Meeting of the Air Pollution Control Association, New York, New York, June 11-15, 1961.

Late in 1966 BCR was requested to submit to NAPCA a special report containing information on the Lower Kittanning seam, the report to contain the available data necessary to make an economic evaluation of the production of sulfuric acid from pyrite in raw coal. This confidential report was made possible through the cooperation of the Barnes and Tucker Company, the North American Coal Corporation, and the Pennsylvania Electric Company. The latter company is the owner-operator of the Seward Power Station where Bituminous Coal Research, Inc., was undertaking a research program on the BCR conceptual process of coal beneficiation by pulverization, air classification, and cleaning under co-sponsorship with twelve Eastern utilities.

Because of this common interest in pyrite removal as a means of desulfurization, BCR was requested to submit a cooperative research proposal to NAPCA to evaluate the deep cleaning of pyrite from utility coals.

On June 1, 1967, Bituminous Coal Research, Inc., was awarded a contract, No. PH 86-67-139, to develop additional data on the first 30 coals processed by Commercial Testing and Engineering Company, under their contract with NAPCA.

B. Objective

The objective of the work undertaken by Bituminous Coal Research, Inc., was twofold; first, to extend the washability data to finer sizes of coal, and second, to evaluate coal cleaning methods and techniques for removing pyritic sulfur from the fine-sized coal. From BCR's previous work with pyrite removal from finely sized coal, two size consists were of interest in the washability studies.

The first was the 30 mesh x 0 size as this was the lower limit in sizing that would contain a size range of pyrite typical of a utility pulverizer's recycle load. It is this recycle material that can possibly be removed from the utility pulverizer, wet-cleaned to remove the pyrite, and the clean dewatered coal reinjected into the feed to the pulverizer without thermal drying.

The second size range of interest was each coal's "as fired," or p.c. grind. It is at this stage of pulverization that maximum pyrite liberation occurs, insofar as the coal's present utilization is concerned. Therefore, it is obvious that the maximum degree of potential pyrite removal has also been reached with each coal's p.c. grind.

The evaluation of coal cleaning methods and techniques has to date been limited to studies involving the coarser, or 30 mesh x 0, grind.

C. Approach

The work was divided into three phases. Phase I was a comprehensive evaluation of the pyrite liberation and removal characteristics of U.S. utility coals when pulverized to the two fine grinds of interest (30 mesh x 0 and each coal's pulverized coal grind). All samples were subjected to float-sink separation at a 1.60 specific gravity to produce a reduced sulfur clean coal fraction and a sulfur-enriched refuse. The degree of both total sulfur and pyritic sulfur reduction obtained was calculated from the chemical analysis of (1) the R.O.M. coal and (2) the clean coal product produced from the float-sink process.

Seventy coals were subjected to Phase I evaluations utilizing a portion of the samples obtained by Commercial Testing and Engineering Company (CTECO) for their washability studies at topsizes of 1-1/2 inch, 3/8 inch, and 14 mesh.

Phase II of the program consisted of a performance evaluation of three existing coal cleaning or mineral preparation devices. Six coals were selected on the basis of Phase I evaluations. Tests were conducted on large lots of coal obtained at the mine by BCR personnel. Test evaluations were made on separations obtained with feed rates between 0.5 and 1.25 ton per hour using the 30 mesh x 0 size coal. Total sulfur and pyritic sulfur reductions were again utilized to measure the degree of success. The concentrating table, the concentrating spiral, and the compound water cyclone were the three commercially available units tested in Phase II.

Phase III of the program, utilizing the coal samples supplied by CTECO, was a selective evaluation of 10 of the coals tested under Phase I to determine their suitability for pyrite reduction by the BCR conceptual process of pyrite removal at the utility pulverizer. A combination of air classification and float-sink separation at a specific gravity of 1.60 was utilized to construct the potential composition of the feed to the utility burners.

The air classification was utilized to effect a coarse-fine separation with the coarse fraction being pyrite-enriched. The entire quantity of fine coal combined with the 1.60 specific gravity float material from the coarse fraction constituted the clean coal or potential burner feed. Total sulfur and pyrite sulfur reductions were again utilized to evaluate performance.

II. CONCLUSIONS AND RECOMMENDATIONS

A. Phase I Evaluations

During evaluation of the pyrite liberation and removal characteristics of seventy different utility coals when pulverized to a topsize of 30 mesh and to the coal's p.c. grind, an extensive quantity of information has been generated. Certain evaluations have been made in this report which may appear to some users of this report to be too general in nature. Since all of the information generated by BCR on the Phase I evaluations is attached to this report as Appendix A, each individual reader can make his own evaluation in any specific area of interest.

The seventy coals tested came from three geographical areas: Western Pennsylvania, Eastern Ohio, and Illinois. Maximum pyritic sulfur reduction obtained at the 30 mesh x 0 size was 93.7 percent with an Ohio No. 6 coal; the minimum pyritic sulfur reduction obtained was 51.2 percent with an Illinois No. 6 coal. At the p.c. grind, 95.0 percent of the pyritic sulfur was removable from a Pennsylvania Lower Freeport coal while the minimum percentage of pyritic sulfur removal was 54.5 percent with a Pennsylvania Middle Kittanning coal which had a very low R.O.M. pyritic sulfur content. Total sulfur reductions covered a much wider range since the percentage of organic sulfur, which was not removable, quite significantly affected the percent reduction. This leads to several conclusions and recommendations for future work.

If pyrite removal is to stand on its own merit as a method of reducing sulfur dioxide emissions, a high percentage of total sulfur reduction must be obtained at the selected size for processing. If limestone or dolomite injection is to be considered as a supplement to the removal of pyrite from the coal, the percentage of pyritic sulfur reduction must be fairly high and the effect of a high organic sulfur content on poor total sulfur reduction becomes less significant.

Consideration should be given to evaluating the pyrite liberation characteristics of more Western Kentucky and Illinois coals having moderately high organic sulfur contents.

Single gravity separations on the 30 mesh x 0 and the p.c. grinds should be expanded for some coals to include separations at two higher gravities. An evaluation of the potential trade off between increased coal yield and sulfur reduction would then be possible for the fine sizes.

The data sheets for the Phase I evaluations are contained in Appendix A of this report, Tables A-1 to A-70.

B. Phase II Evaluations

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The results of the coal cleaning tests with the concentrating table were, in general, excellent. The total sulfur content of the clean coal obtained from the table tests with the three Pennsylvania coals and one of the Ohio coals correlated very well with the Phase I float-sink test results. A significant lack of correlation in the Phase I and Phase II results was noted in the chemical composition of the 1.60 float fraction of two additional Ohio coals.

Additional coals should be tested on the concentrating table and Phase I evaluations should be made on each lot processed. This would either eliminate the discrepancies between the Phase I and Phase II results or indicate that more detailed studies should be made on the composition of the clean coal obtained in the Phase II studies, which we have assumed could contain no misplaced sink material.

The results obtained with the compound water cyclone and concentrating spiral were not encouraging when judged purely on the separations obtained. While the concentrating table did an excellent job of removing the additional pyrite liberated when the precleaned coal was pulverized from a 3/8 inch topsize to a 30 mesh topsize, these two units did little in further reducing the sulfur content in the 30 mesh coal.

It is our opinion that the pyrite was much finer than the coal, relatively speaking, thus making separation in the cyclone impossible. A possible alternate to the present compound water cyclone test procedure would be to separate the feed into two size fractions, using a rapped sieve bend with a 200 mesh aperture, and processing each fraction independently in the compound water cyclone.

The extremely small percentage of pyrite being removed in the second stage of the two-stage cleaning technique hurts the performance of the concentrating spiral. Improvements in its operation could probably be made, but a new test procedure would have to be developed.

Concentrating table test data can be found in Appendix B, Tables B-1 to B-19; compound water cyclone test data in Appendix C, Tables C-1 to C-30; and concentrating spiral test data in Appendix D, Tables D-1 to D-13.

C. Phase III Evaluations

A wide range in sulfur reduction was obtained in the Majac air classification tests. This was expected, since the coals were not selected on their predicted ease of separation. Additional tests of this type are not recommended at this time. Total sulfur reductions of 40 percent could be significant if the cost of the process per ton of coal is low. If this should prove to be the case, numerous additional Phase III evaluations should be made.

The test data for the Phase III evaluations appear in Appendix E, Tables E-1 to E-12.

III. PHASE I EVALUATIONS

A. Test Procedure

Representative samples of each of the 70 utility coals were supplied to Bituminous Coal Research, Inc., by Commercial Testing and Engineering Company of Chicago, Illinois. Each sample consisted of three drums of coal split-out from the quantities obtained by Commercial Testing for their washability studies at topsizes of 1-1/2 inches, 3/8 inches, and 14 mesh. Initially, as shown in Figure 1, each three-drum sample was crushed to minus 1/4 inch with two drums of coal being retained for possible use in the Phase III evaluations. The third drum was systematically reduced in quantity and in size until three 8-ounce samples of minus 20 mesh coal remained for further test work. One 8-ounce fraction was utilized to obtain proximate analysis, forms of sulfur, and Btu of the "as-received," or R.O.M. coal.

The second 8-ounce sample of coal was pulverized and stage-ground until the entire quantity was minus 30 mesh in size. The sample was then subjected to float-sink analysis at 1.60 specific gravity. Tetrachloroethylene, with a specific gravity of 1.62, diluted to 1.60 with methanol, was used as the media solution. An International centrifuge, Size 2 Model V, was utilized to effect the separation. The centrifuge is shown in Figure 2, while Figure 3 shows a general view of the float-sink laboratory. The 1.60 float and 1.60 sink fractions were analyzed for moisture, ash, and total sulfur.

The initial chemical data received on the float-sink fractions of both the 30 mesh and 200 mesh tests made us suspicious that the generally-accepted standard technique for conducting float-sink tests on fine-sized coal with a centrifuge was not yielding reliable data. Chemical data on subsequent tests, together with Commercial Testing's float-sink and chemical data on the coarser sizes of the same coals, confirmed our suspicions.

The trend that we were establishing in our float-sink tests indicated that the finer a coal was ground the less cleanable it became. This, of course, is impossible; and an investigation was initiated to identify the problem and determine what corrective measures had to be taken to eliminate it.

The investigation showed that a small amount of surface moisture on fine coal causes it to agglomerate. The separation obtained, even in the centrifuge, was on agglomerates rather than on individual particles. The amount of agglomeration seemed to vary widely between coals but was present to some degree with all of them. The end result of this agglomeration was a large quantity of misplaced material, both in the float and in the sink.

Complete drying of the sample immediately prior to the float-sink process, together with the addition of a dispersing agent to the gravity liquid and sample, solved the problem, as shown in Table 1.

The revised standard procedure for float-sink analysis is contained in this report in Appendix F-1.

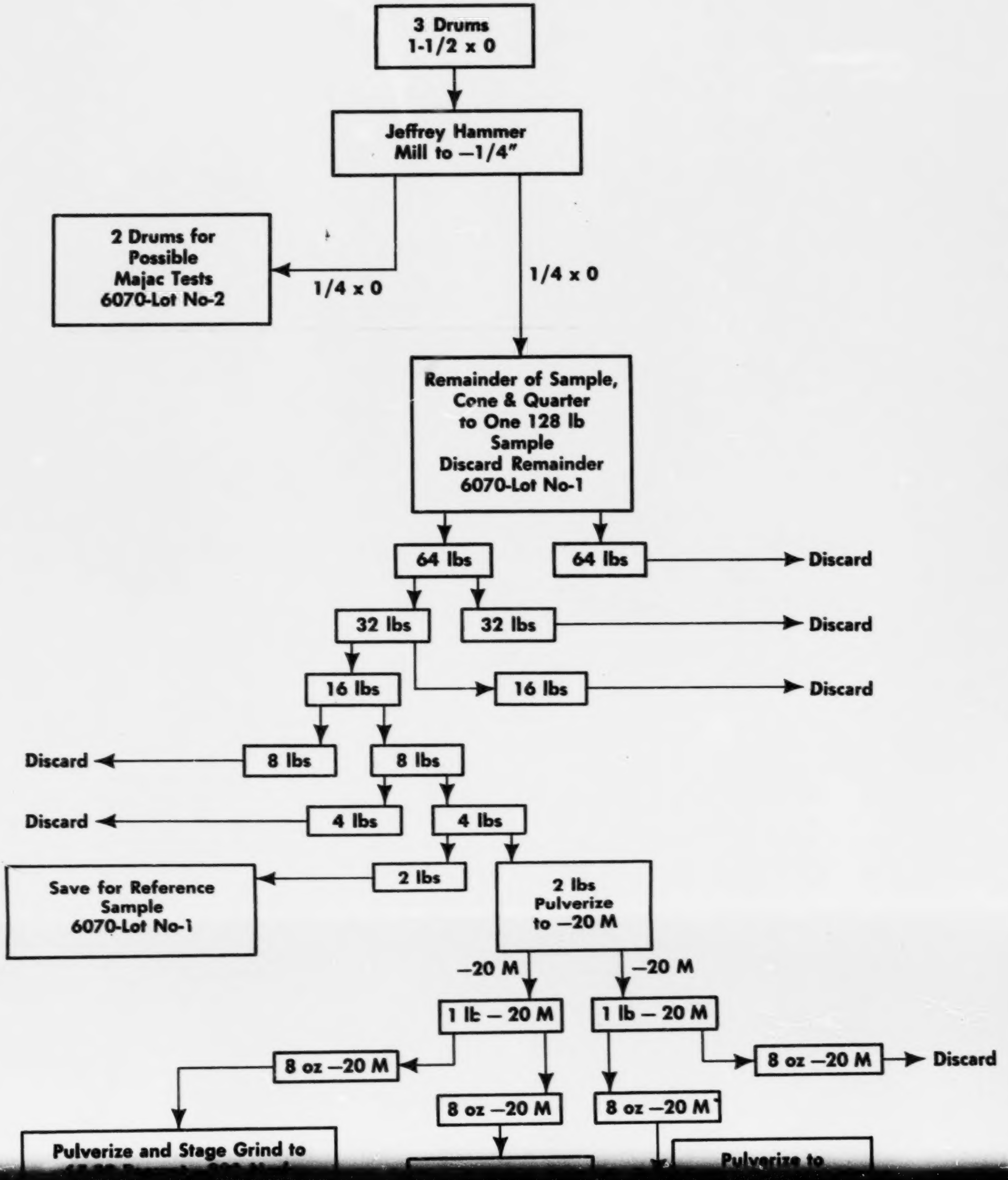
Table 2 is a sample copy of the data sheet utilized in the Phase I investigation. The top row of data is the chemical analysis of the "as received," R.O.M. coal. These values were used as the base figures in determining subsequent sulfur reduction. The second grouping of data is that obtained on the float-sink fractions of the 30 mesh coal. The line of figures opposite "composite" is the mathematically recombined analysis of the float-and-sink material and yields the analysis of the feed material for that particular test. These figures should compare favorably with the "as received" analysis.

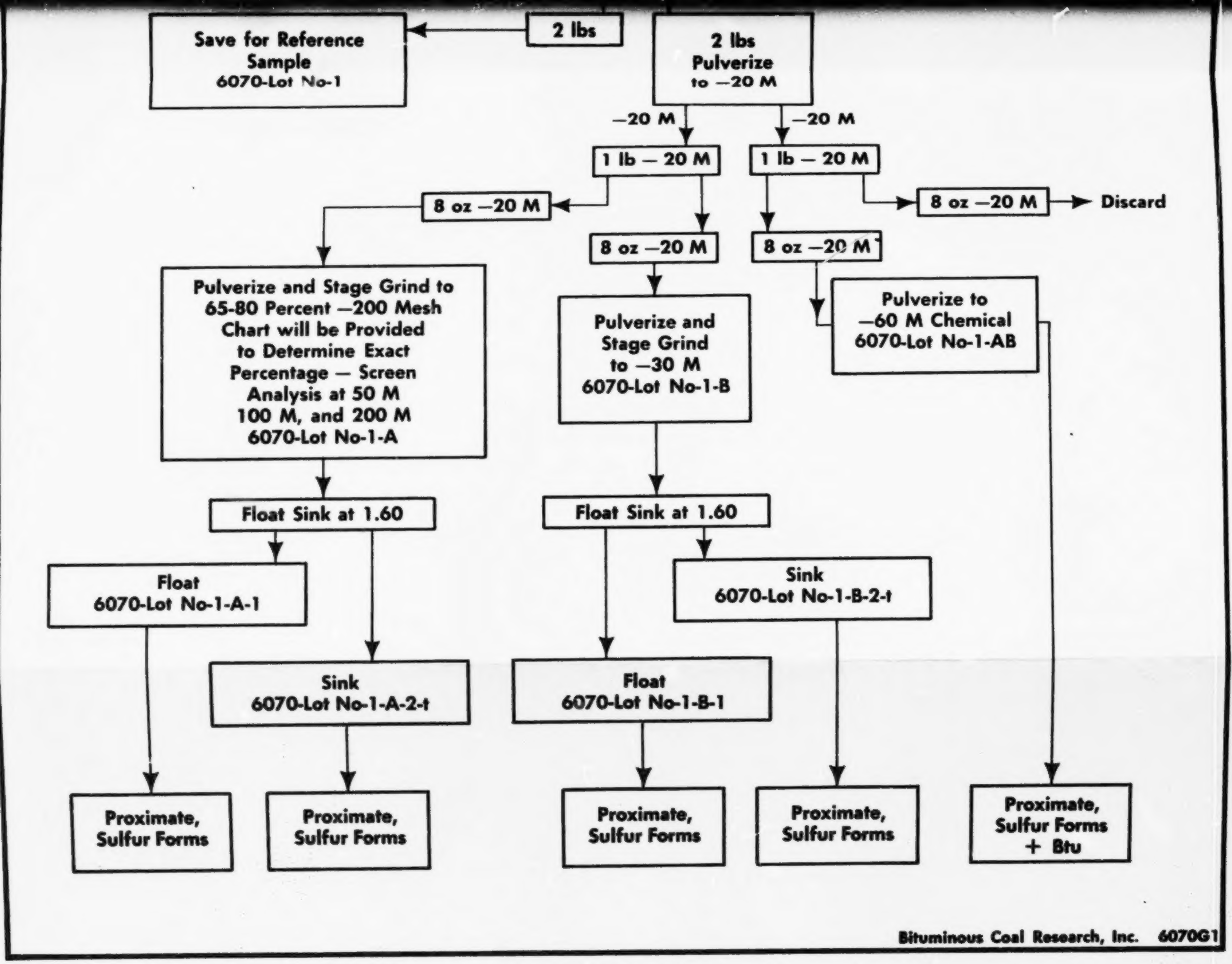
If the ash in the 30 mesh float-sink test is used for an example, it can be seen that the float material constituted 86.6 percent of the total and had an analytically-determined ash content of 4.42 percent. The remainder, or 13.4 percent of the total, was sink material with an analytically-determined ash content of 53.4 percent. Combining these two fractions mathematically yields 100 percent of the material with an ash value of 10.98 percent. This value compares favorably with the 10.4 percent ash obtained by chemical analysis on the "as received" coal. This procedure was utilized as a safeguard against sampling and analytical errors.

The level of sulfur reduction was determined by using the difference between the sulfur content of the "as received" coal and the sulfur content of the 1.60 float material obtained in the float-sink tests. The 64 percent total sulfur reduction shown in Table 2 for the 30 mesh float-sink test represents the reduction from 2.50 percent level of total sulfur shown in the "as received" analysis to the 0.90 percent level of total sulfur in the 1.60 float material.

In a few cases it was necessary to calculate the pyritic sulfur values of the sink fractions, since the chemical analysis indicated that there was more pyritic sulfur present in the sample than there was total sulfur. This, of course, is impossible. It was caused by the incomplete extraction of the non-pyritic iron with hydrochloric acid from the sink fractions. This necessary calculation did not detract from the value of the checks, since neither the total ash nor total sulfur were affected by analysis problems.

This was one of numerous minor problems encountered with chemical analysis of high sulfur samples. A general discussion of these problems can be found in Appendix G, a special report by Ronald K. Young, BCR Supervisor of Analytical Services.

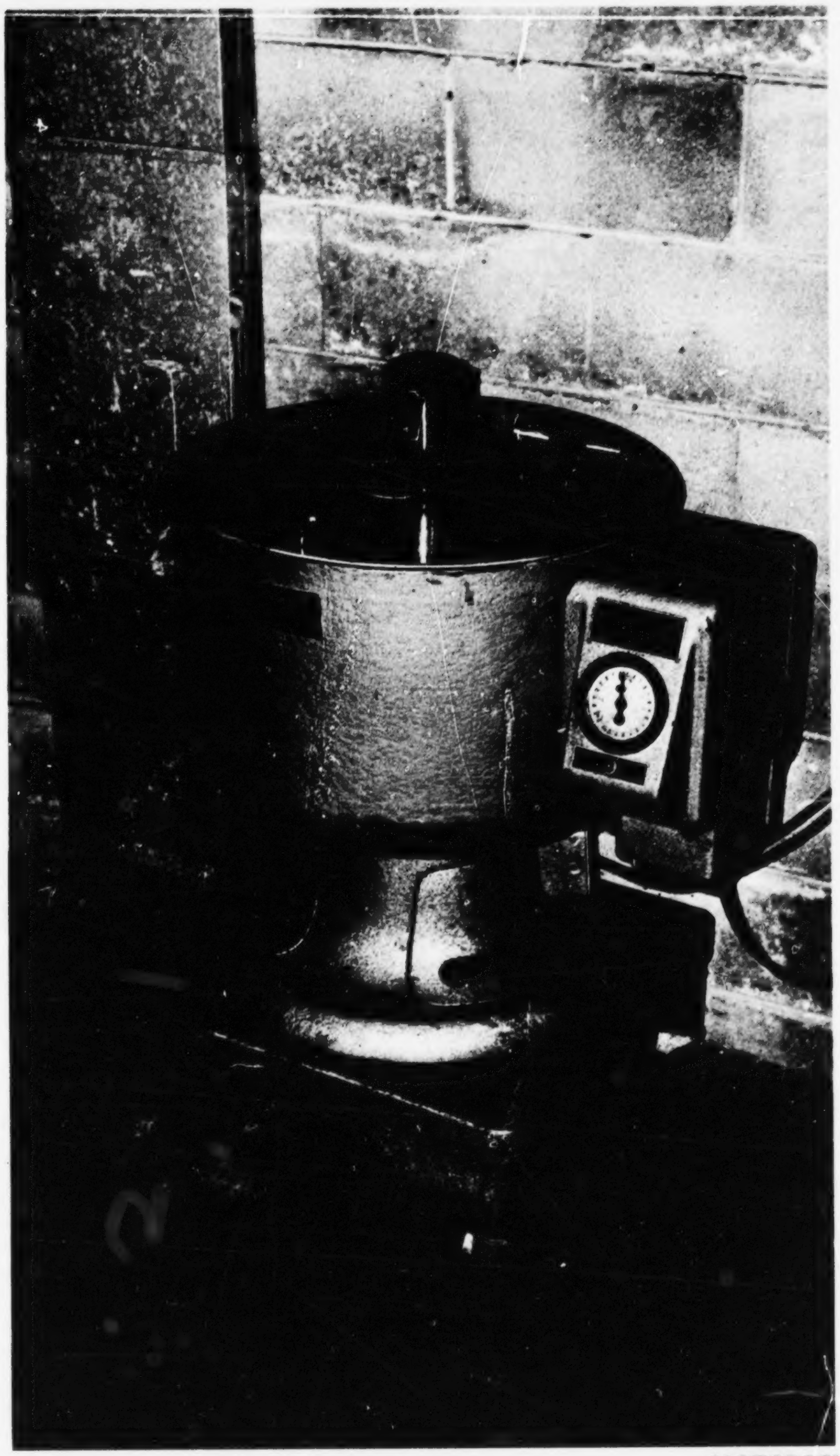

3 Drums
1-1/2 x 0
Jeffrey Hammer
Mill to –1/4"
1/4 x 0
2 Drums for
Possible
Majac Tests
6070-Lot No-2
1/4 x 0
Remainder of Sample,
Cone & Quarter
to One 128 lb
Sample
Discard Remainder
6070-Lot No-1
64 lbs
64 lbs
Discard
32 lbs
32 lbs
Discard
16 lbs
16 lbs
Discard
Discard
8 lbs
8 lbs
Discard
4 lbs
4 lbs
Save for Reference
Sample
6070-Lot No-1
2 lbs
2 lbs
Pulverize
to –20 M
–20 M
–20 M
1 lb – 20 M
1 lb – 20 M
8 oz –20 M
8 oz –20 M
Discard
8 oz –20 M
8 oz –20 M
Pulverize and Stage Grind to
Pulverize to


2 lbs
Save for Reference Sample 6070-Lot No-1
2 lbs Pulverize to –20 M
–20 M
–20 M
1 lb – 20 M
1 lb – 20 M
8 oz –20 M
8 oz –20 M
8 oz –20 M
8 oz –20 M
Discard
Pulverize and Stage Grind to 65-80 Percent –200 Mesh Chart will be Provided to Determine Exact Percentage — Screen Analysis at 50 M 100 M, and 200 M 6070-Lot No-1-A
Pulverize and Stage Grind to –30 M 6070-Lot No-1-B
Pulverize to –60 M Chemical 6070-Lot No-1-AB
Float Sink at 1.60
Float Sink at 1.60
Float 6070-Lot No-1-A-1
Sink 6070-Lot No-1-A-2-t
Float 6070-Lot No-1-B-1
Sink 6070-Lot No-1-B-2-t
Proximate, Sulfur Forms
Proximate, Sulfur Forms
Proximate, Sulfur Forms
Proximate, Sulfur Forms
Proximate, Sulfur Forms + Btu

Bituminous Coal Research, Inc. 6070G1

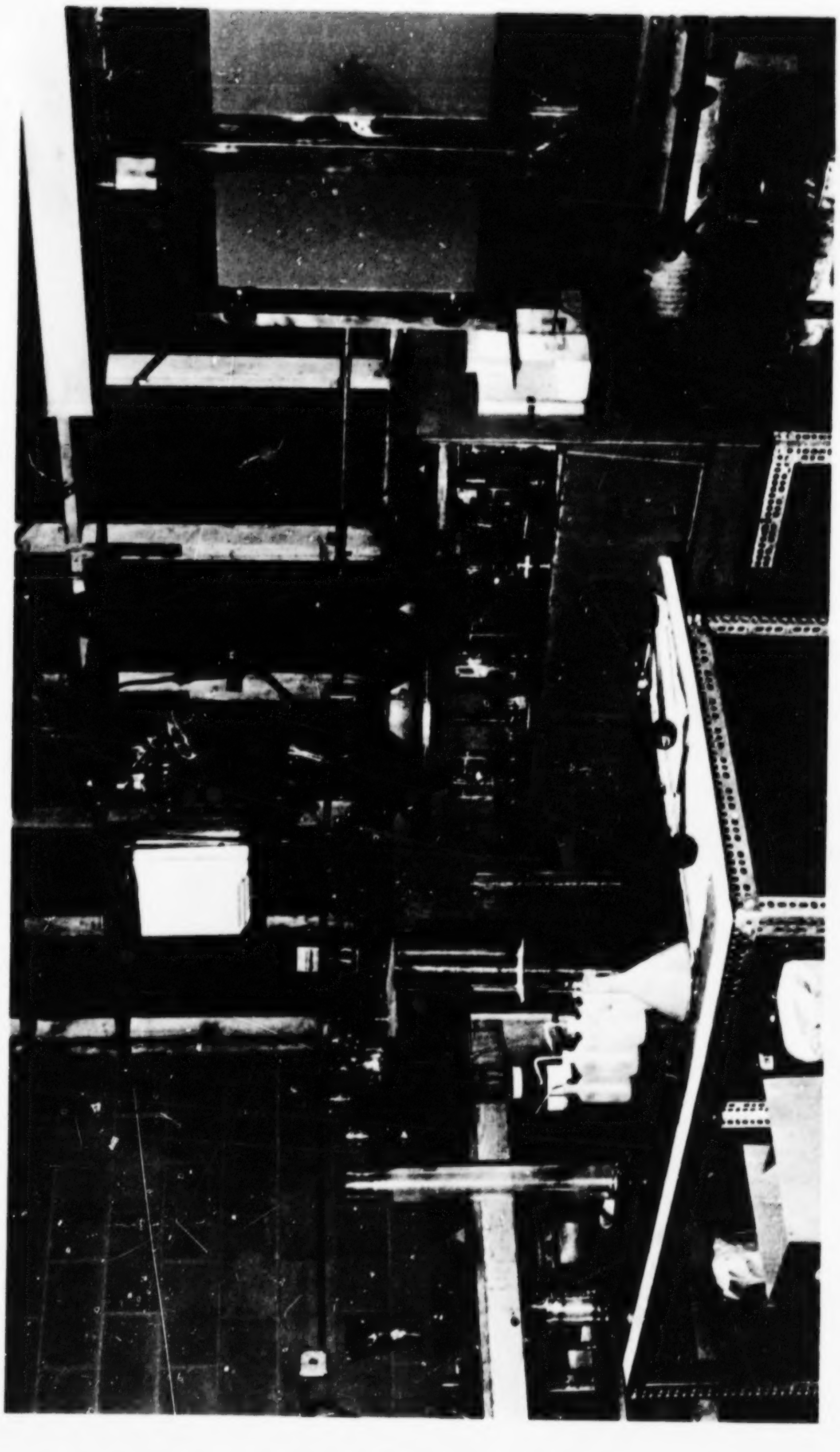
Figure 1. Flow Sheet for Theoretical Evaluation from 3 Drum Samples (From Commercial Testing)

B



(6070P39)

Figure 2. Centrifuge Utilized to Effect the Separation in the Float-Sink Test



(6070P37)

Figure 3. General View of Float-Sink Laboratory

TABLE 1. PERCENT ASH IN 1.60 FLOAT MATERIAL OF RUN-OF-MINE COAL
CRUSHED TO VARIOUS SIZES, SHOWING THE EFFECT OF AGGLOMERATION
IN THE FLOAT-SINK PROCESS AS RELATED TO SIZE

Size of Crushed or Pulverized Run-of-Mine Coal	Original Float-sink Technique		Revised Float-sink Technique	
	Ash, Percent	Pyritic Sulfur, Percent	Ash, Percent	Pyritic Sulfur, Percent
1-1/2 inch x 0 CTECO	6.13	1.01	6.13	1.01
3/8 inch x 0 CTECO	4.92	0.57	4.92	0.57
14 mesh x 0 CTECO	5.06	0.39	5.06	0.39
30 mesh x 0 BCR	5.92*	0.65*	4.42	0.32
200 mesh x 0 BCR	9.28*	1.35*	4.37	0.15

* Known to be caused by misplaced material due to agglomeration

TABLE 2. SAMPLE COPY OF PHASE I DATA SHEET

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Coal Identification 6-A SEAM, HARRISON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1735

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.92	10.4	38.4	51.2	2.50	0.01	1.86	0.63	13,234

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.6	4.42	0.90	0.32	82.8	64.0
Sink at 1.60	13.4	53.4	11.5	11.2		
Composite	100.0	10.98	2.32	1.78		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.9	4.37	0.78	0.15	91.9	69.8
Sink at 1.60	14.1	49.9	12.8	12.3		
Composite	100.0	10.79	2.47	1.86		

The p.c. grind was prepared after the Btu content and fixed carbon content of the R.O.M. coal had been determined and the correct percentage of minus 200 mesh had been selected from Table 3.

The samples of R.O.M. coal were stage-ground until (1) the correct percentage (±1.0 percent) of minus 200 mesh material was obtained, and (2) all of the material passed a 50 mesh screen. The p.c. grind samples were than processed in the same manner as the 30 mesh samples, previously described.

TABLE 3. REQUIRED PULVERIZED COAL FINENESS
PERCENT THROUGH NO. 200 SIEVE*

Fuel Classification (Dry Basis)

Fixed Carbon, Percent	Fixed Carbon, Percent	Fixed Carbon, Percent	Fixed Carbon, Below 69 Percent		
97.9 to 86	85.9 to 77	76.9 to 69	Btu Above 12,900	Btu From 12,900 to 11,000	Btu Below 11,000
80	75	70	70	65	60

* Steam, Its Generation and Use, The Babcock and Wilcox Company, p. 17-2

The complete standard procedure for this phase of the test work appears in Appendix F, BCR Standard Procedure F-2.

The data sheets for the 70 coals tested under Phase I of the program appear in Appendix A, pages A-1 through A-70.

B. Summary of Results

In order to fully appreciate the sulfur reductions obtainable at the extremely fine sizes of pulverization studied under the BCR contract, it is necessary to compare BCR's data with the data obtained by Commercial Testing and Engineering Company for the larger topsizes. Table 4 shows the percent pyritic sulfur reduction obtained at a 1.60

TABLE 4. PYRITIC SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL

Coal Identification Lot - Seam	Location County, State	Pyritic Sulfur, Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float			
			CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. Grind
1725 - Pittsburgh	Marion, W. Va.	1.07	54.7	73.8	66.4	78.5
1728 - No. 9	Morgan, Ohio	2.92	49.8	56.3	60.1	72.4
1729 - Nos. 6, 7, & 8	Athens, Ohio	2.82	49.6	61.3	68.1	80.9
1730 - No. 6	Perry, Ohio	3.70	74.6	71.8	81.1	85.1
1733 - No. 8	Belmont, Ohio	2.84	43.5	59.5	59.1	74.3
1734 - No. 6-A	Harrison, Ohio	1.42	48.9	71.0	76.8	87.3
1735 - No. 6-A	Harrison, Ohio	1.86	63.5	77.5	82.8	91.9
1743 - No. 5-A	Jefferson, Ohio	3.08	52.2	67.3	71.4	80.8
1744 - No. 4	Mahoning, Ohio	1.80	64.5	77.3	81.7	87.2
1745 - No. 6	Columbiana, Ohio	1.79	62.1	77.8	82.1	92.2
1746 - Lower Kittanning	Cambria, Pa.	0.90	76.6	80.3	76.7	87.8
1747 - Lower Kittanning Lower Freeport	Cambria, Pa.	1.84	79.4	82.7	83.2	90.8
1748 - Lower Kittanning	Indiana, Pa.	4.14	65.1	63.0	75.4	83.3
1749 - Lower Kittanning	Cambria, Pa.	0.94	83.5	82.4	84.0	91.5
1750 - Upper Freeport	Westmoreland, Pa.	3.22	74.4	76.1	82.3	88.8
1751 - Upper Freeport	Indiana, Pa.	1.31	62.8	71.7	78.6	84.7
1752 - Upper Kittanning	Somerset, Pa.	2.31	87.9	91.4	93.1	93.9
1755 - Lower Kittanning	Indiana, Pa.	4.00	77.7	76.5	86.2	90.5
1756 - Lower Kittanning	Indiana, Pa.	4.56	74.6	75.2	82.7	88.6
1757 - Freeport	Grant, W. Va.	2.16	65.7	67.2	75.9	85.6
1762 - No. 8	Harrison, Ohio	2.32	50.3	61.5	66.4	77.2
1763 - Freeport	Preston, W. Va.	0.98	73.4	78.6	83.7	85.7
1764 - Bakerstown	Grant W. Va.	2.85	82.8	82.6	90.2	92.6

TABLE 4. PYRITIC SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL (Continued)

Coal Identification Lot - Seam	Location County, State	Pyritic Sulfur, Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float			
			CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. Grind
1765 - No. 8	Jefferson, Ohio	2.26	39.9	46.6	51.3	69.9
1766 - No. 9	Belmont, Ohio	1.88	45.3	50.0	59.0	74.5
1767 - No. 6	Coshocton, Ohio	2.09	61.8	52.2	70.3	71.3
1768 - No. 8	Jefferson, Ohio	3.69	31.4	44.7	56.6	74.3
1770 - Thick Freeport	Allegheny, Pa.	1.68	69.1	75.2	82.1	88.1
1771 - Lower Freeport	Armstrong, Pa.	1.89	58.2	73.6	81.0	90.5
1772 - Upper Freeport	Armstrong, Pa.	1.93	78.0	85.0	88.1	91.7
1773 - Double Freeport	Armstrong, Pa.	1.11	70.4	84.6	78.4	83.8
1774 - No. 5	Sullivan, Ind.	3.94	61.9	66.5	72.8	82.0
1775 - No. 5	Lawrence, Ohio	3.93	64.0	69.5	76.6	82.2
1788 - No. 2	Peoria, Ill.	4.10	70.6	69.8	75.4	82.7
1789 - No. 5	Knox, Ill.	5.60	68.3	75.8	73.7	80.7
1790 - No. 5	Fulton, Ill.	2.30	53.5	59.1	65.2	76.5
1791 - No. 2	Montgomery, Ill.	3.03	60.5	59.4	71.9	82.2
1792 - No. 6	Jefferson, Ill.	0.84	32.5	31.5	51.2	60.7
1793 - No. 5	Perry, Ill.	2.57	62.6	64.9	67.7	77.8
1794 - No. 6	Jefferson, Ill.	1.68	50.3	54.4	62.5	73.8
1795 - No. 5	Franklin, Ill.	1.92	62.6	62.7	74.5	80.7
1796 - No. 6	Williamson, Ill.	2.82	72.3	74.2	78.0	84.0
1797 - No. 6	Frenklin, Ill.	0.69	42.1	46.7	52.2	63.8
1798 - No. 2	Fulton, Ill.	3.90	54.0	66.8	69.5	73.8
1817 - No. 5	Saline, Ill.	1.80	57.7	61.8	53.3	61.7
1818 - No. 6	Saline, Ill.	3.54	74.2	70.8	76.8	85.0
1819 - No. 6	Hopkins, Ky.	1.84	61.5	65.7	69.6	76.1
1820 - No. 6	Columbiana, Ohio	1.76	90.1	92.2	93.7	93.7
1821 - No. 7-A	Jefferson, Ohio	0.98	75.0	73.4	85.7	90.8

TABLE 4. PYRITIC SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL (Continued)

Coal Identification Lot - Seam	Location County, State	Pyritic Sulfur, Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float			
			CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. Grind
1822 - No. 6	Tuscarawas, Ohio	4.25	80.6	79.2	82.4	87.5
1823 - No. 6	Tuscarawas, Ohio	3.23	73.0	74.2	76.5	79.6
1824 - Lower Kittanning	Indiana, Pa.	3.18	81.4	81.6	84.3	90.3
1825 - Kittanning	Armstrong, Pa.	4.00	52.4	64.2	64.5	77.5
1826 - Lower Freeport	Clearfield, Pa.	2.01	70.9	74.1	84.6	95.0
1827 - Lower Freeport	Indiana, Pa.	1.77	82.9	84.5	88.1	92.1
1828 - Upper Freeport	Armstrong, Pa.	2.20	73.9	78.9	79.1	85.9
1829 - Lower Kittanning	Armstrong, Pa.	3.10	75.6	77.7	79.4	86.5
1830 - Upper Freeport	Armstrong, Pa.	1.64	79.3	83.1	86.0	90.2
1831 - Upper Clarion	Clarion, Pa.	1.92	75.0	77.3	82.3	82.3
1832 - No. 4-A	Jackson, Ohio	1.93	55.9	60.0	68.9	77.2
1833 - No. 7-A	Guernsey, Ohio	2.62	56.5	57.8	53.4	63.7
1834 - Upper Freeport	Clearfield, Pa.	2.86	49.5	68.1	78.7	88.5
1835 - No. 5	Muskingum, Ohio	4.62	75.4	79.0	90.5	91.1
1836 - Upper Kittanning	Cambria, Pa.	1.00	83.3	80.8	84.0	82.0
1837 - Upper Freeport	Cambria, Pa.	3.19	78.5	78.9	81.2	93.1
1838 - No. 6	Muskingum, Ohio	1.55	64.3	65.7	76.1	81.9
1839 - Middle Kittanning	Clearfield, Pa.	8.45	49.5	56.0	61.8	75.6
1840 - Lower Kittanning	Indiana, Pa.	2.63	74.0	75.8	81.4	89.4
1841 - Middle Kittanning	Clarion, Pa.	0.22	16.7	45.5	59.1	54.5
1842 - Lower Clarion	Clarion, Pa.	7.67	72.0	78.6	73.8	79.5

specific gravity at topsizes of 3/8 inch, 14 mesh, 30 mesh, and at the p.c. grind for all 70 of the coals tested. Total sulfur reductions obtained for the 70 coals are shown in Table 5. These data are shown graphically in Figures 4 and 5. In addition, the sulfur reductions obtainable by cleaning the 1-1/2 inch topsize R.O.M. coal at a 1.60 specific gravity are also shown. Figure 4 shows that by cleaning the 1-1/2 inch topsize at a 1.60 specific gravity, it is possible to reduce the pyritic sulfur content of 51.5 percent of the coals tested (36 coals) by 50 to 60 percent. Also, at this topsize and separating gravity, five of the coals, or approximately 7 percent of those tested, were reduced in pyritic sulfur content to the 70 to 80 percent reduction level.

At the opposite end of the size range, in the p.c. grind, and again referring to Figure 4, all 70 coals (100 percent) were reduced in pyritic sulfur content by 50 to 60 percent. Seventeen (24 percent) of the coals tested at the p.c. grind were reduced in pyritic sulfur content in the 90 to 100 percent range.

The greatest reduction in pyritic sulfur content occurred by reducing the topsize of the coal from 1-1/2 inches to 3/8 inches, as shown by the horizontal displacement between these two curves in Figure 4. In general, the second largest reduction of pyritic sulfur occurred when the coal was reduced from a topsize of 30 mesh to its p.c. grind.

This trend was also followed in total sulfur reduction, as shown in Figure 5. Maximum total sulfur reduction ranged from 50 to 60 percent for ten of the coals at the 1-1/2 inch topsize to 80 to 90 percent for one coal at the p.c. grind.

Another interesting evaluation of pyrite liberation and removal can be made when the washability curves of the three topsizes tested by Commercial Testing for individual coals are combined with the BCR data. Curves for six coals have been plotted and are shown in Figures 6 through 11. Figure 6 shows the washability curves for the Ohio No. 6-A seam from Harrison County, Ohio. Two significant reductions in pyritic sulfur are obtainable with this coal as it is reduced in size and cleaned at a 1.60 specific gravity. The first occurs when the coal is crushed from a 1-1/2 inch topsize to a 3/8 inch topsize, and the second occurs when the coal is pulverized from its 30 mesh topsize to its p.c. grind. The greatest reduction (1.05% to 0.6%) occurs between the 1-1/2 inch and the 3/8 inch topsize, indicating that there is a large quantity of coarse pyrite in the coal. The large pyritic sulfur reduction between the 30 mesh grind and the p.c. grind indicates that there is also a relatively large amount of extremely fine pyrite present in this coal.

The pyritic sulfur reductions obtainable in the mixture of Lower Kittanning and Lower Freeport Seam from Cambria County, Pennsylvania, (Figure 7) are not quite as significant as those in the Ohio No. 6-A

TABLE 5. TOTAL SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL (Continued)

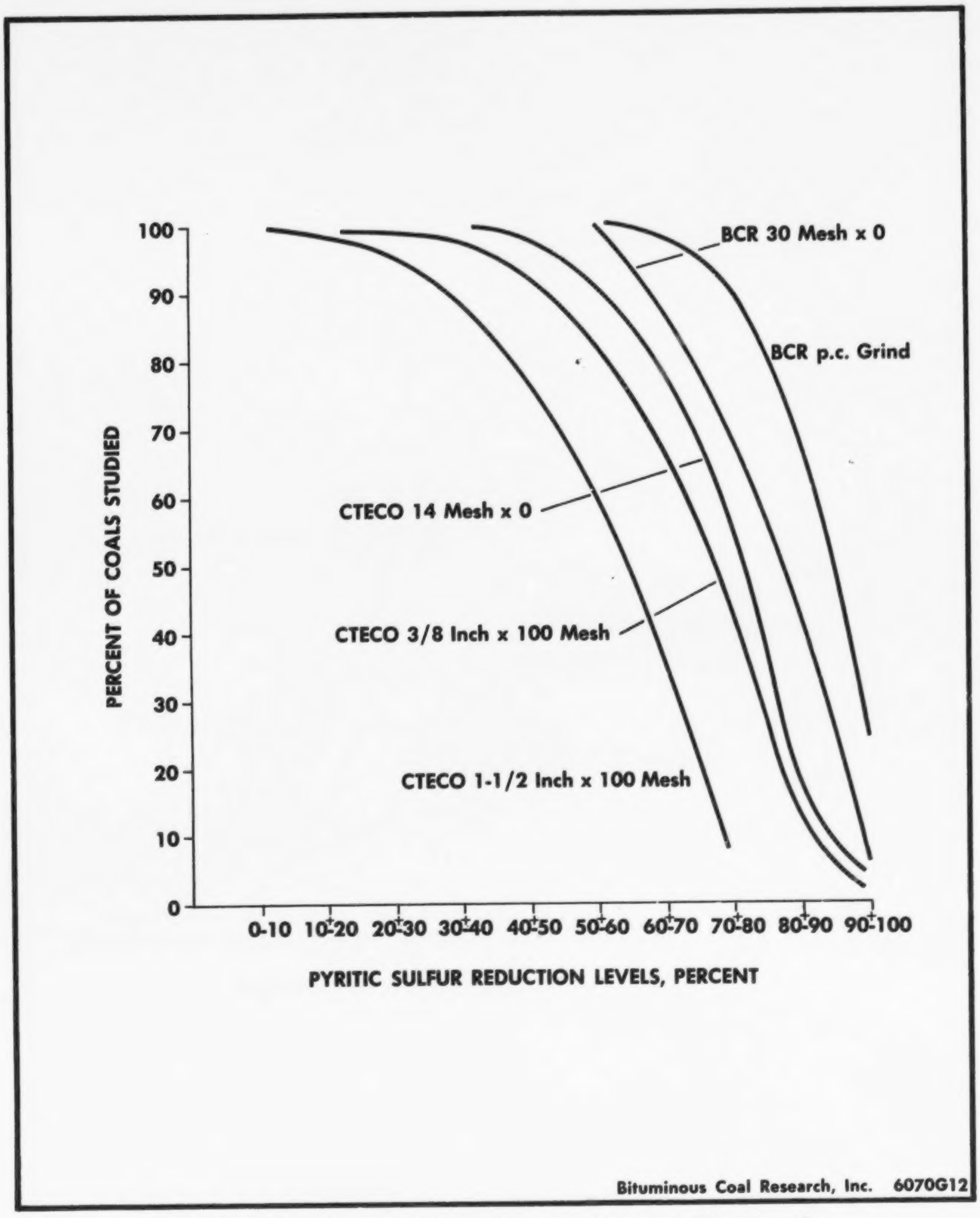
Coal Identification Lot - Seam	Location County, State	Total Sulfur, Weight Percent Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. Grind
1766 - No. 9	Belmont, Ohio	3.02	28.1	31.0	36.1	45.7
1767 - No. 6	Coshocton, Ohio	3.70	37.8	31.6	34.5	36.8
1768 - No. 8	Jefferson, Ohio	4.71	19.3	31.3	40.8	55.6
1770 - Thick Freeport	Allegheny, Pa.	2.08	49.2	57.8	66.3	69.2
1771 - Lower Freeport	Armstrong, Pa.	2.54	41.0	52.4	63.0	70.1
1772 - Upper Freeport	Armstrong, Pa.	2.43	55.4	60.4	67.5	70.4
1773 - Double Freeport	Armstrong, Pa.	1.69	40.0	50.0	46.7	52.1
1774 - No. 5	Sullivan, Ind.	5.57	40.5	45.7	49.7	56.6
1775 - No. 5	Lawrence, Ohio	4.63	56.1	59.4	65.2	70.2
1788 - No. 2	Peoria, Ill.	5.93	42.8	42.5	51.4	56.3
1789 - No. 5	Knox, Ill.	7.28	52.0	59.3	54.9	59.3
1790 - No. 5	Fulton, Ill.	3.98	25.1	29.5	29.9	37.7
1791 - No. 2	Montgomery, Ill.	5.00	31.1	31.9	39.0	45.0
1792 - No. 6	Jefferson, Ill.	1.35	10.9	9.1	20.7	28.9
1793 - No. 5	Perry, Ill.	4.52	30.8	33.4	37.2	42.0
1794 - No. 6	Jefferson, Ill.	2.34	27.7	30.3	39.3	49.6
1795 - No. 5	Franklin, Ill.	3.02	34.5	34.4	39.7	44.4
1796 - No. 6	Williamson, Ill.	4.38	40.1	44.2	47.3	52.1
1797 - No. 6	Franklin, Ill.	1.14	17.0	19.1	22.8	28.1
1798 - No. 2	Fulton, Ill.	5.35	39.7	50.4	49.7	56.3
1817 - No. 5	Saline, Ill.	2.68	40.7	43.4	33.2	45.9
1818 - No. 6	Saline, Ill.	5.05	49.1	46.8	53.1	60.0
1819 - No. 6	Hopkins, Ky.	2.46	37.3	41.7	43.9	52.4
1820 - No. 6	Columbiana, Ohio	2.19	73.5	77.3	76.7	77.2

TABLE 5. TOTAL SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL

Coal Identification Lot - Seam	Location County, State	Total Sulfur, Weight Percent Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	 CTECO 14 M x 0	 BCR 30 M x 0	 BCR p.c. Grind
1725 - Pittsburgh	Marion, W. Va.	2.30	24.6	35.0	31.7	38.3
1728 - No. 9	Morgan, Ohio	5.35	20.1	23.3	27.1	33.0
1729 - Nos. 6, 7, & 8	Athens, Ohio	4.60	28.2	35.3	37.8	47.0
1730 - No. 6	Perry, Ohio	4.72	55.3	52.6	60.0	63.1
1733 - No. 8	Belmont, Ohio	4.58	15.7	24.7	26.4	36.7
1734 - No. 6-A	Harrison, Ohio	2.18	29.9	44.4	47.7	56.0
1735 - No. 6-A	Harrison, Ohio	2.50	43.5	56.3	64.0	68.8
1743 - No. 5-A	Jefferson, Ohio	3.90	37.4	48.6	55.4	62.6
1744 - No. 4	Mahoning, Ohio	2.54	49.4	59.9	64.6	67.7
1745 - No. 6	Columbiana, Ohio	2.44	49.8	63.9	68.9	75.8
1746 - Lower Kittanning	Cambria, Pa.	1.14	46.8	45.5	46.5	51.8
1747 - Lower Kittanning Lower Freeport	Cambria, Pa.	2.42	59.9	62.9	62.0	69.0
1748 - Lower Kittanning	Indiana, Pa.	4.90	54.6	55.1	63.5	70.0
1749 - Lower Kittanning	Cambria, Pa.	1.50	51.0	52.0	53.3	56.0
1750 - Upper Freeport	Westmoreland, Pa.	3.74	61.8	65.4	71.4	76.7
1751 - Upper Freeport	Indiana, Pa.	1.83	40.9	48.5	57.4	62.8
1752 - Upper Kittanning	Somerset, Pa.	2.71	72.1	76.6	80.1	81.5
1755 - Lower Kittanning	Indiana, Pa.	4.66	64.2	63.3	71.7	74.7
1756 - Lower Kittanning	Indiana, Pa.	5.20	64.3	64.1	70.8	75.8
1757 - Freeport	Grant, W. Va.	2.52	44.5	47.5	57.1	63.9
1762 - No. 8	Harrison, Ohio	3.64	27.2	36.5	41.5	49.5
1763 - Freeport	Preston, W. Va.	1.52	50.6	54.7	59.2	61.8
1764 - Bakerstown	Grant, W. Va.	3.04	68.6	71.2	76.3	77.6
1765 - No. 8	Jefferson, Ohio	3.36	16.3	29.1	33.3	46.1

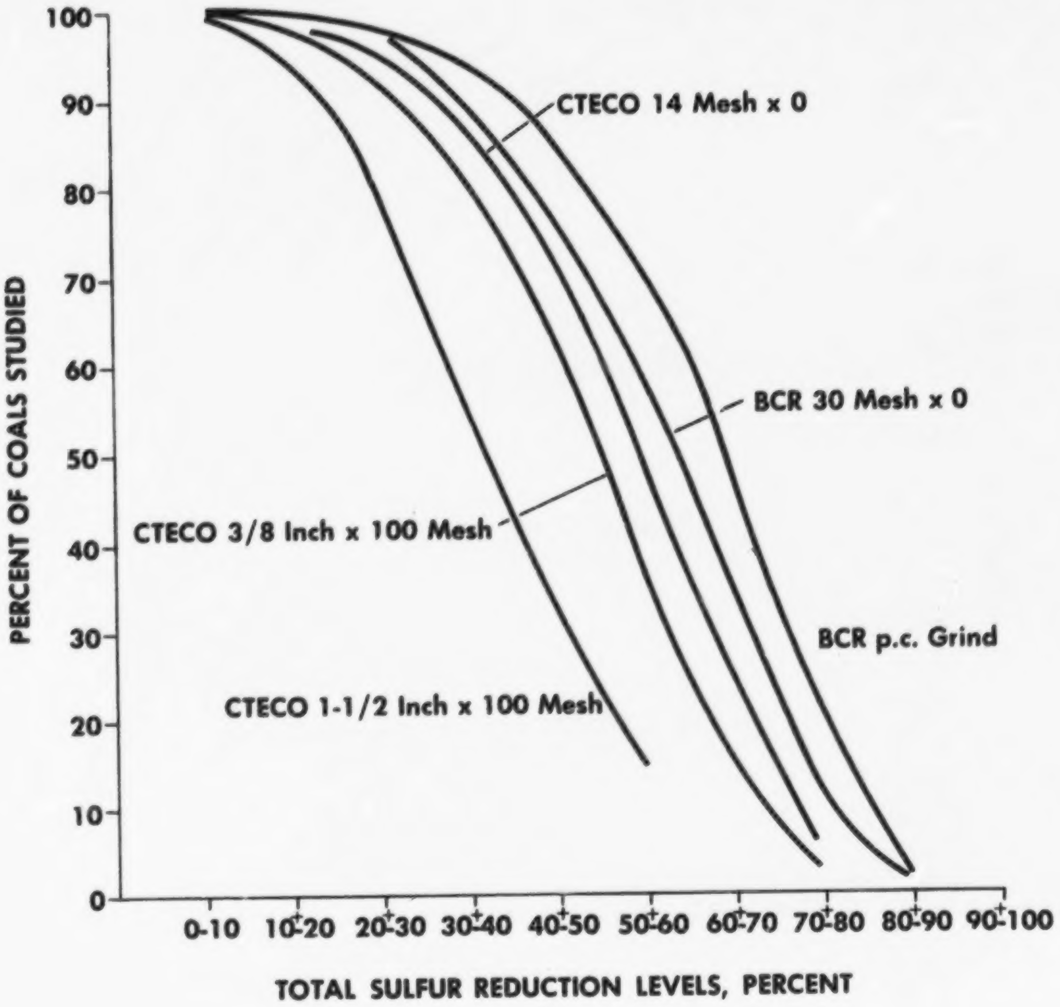
TABLE 5. TOTAL SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL (Continued)

Coal Identification Lot - Seam	Location County, State	Total Sulfur, Weight Percent Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. Grind
1821 - No. 7-A	Jefferson, Ohio	1.43	49.3	47.9	58.0	62.2
1822 - No. 6	Tuscarawas, Ohio	5.81	54.4	52.8	57.7	61.3
1823 - No. 6	Tuscarawas, Ohio	4.85	47.6	47.6	49.1	50.9
1824 - Lower Kittanning	Indiana, Pa.	4.00	63.8	64.0	66.0	69.5
1825 - Kittanning	Armstrong, Pa.	4.83	42.7	53.0	53.2	64.0
1826 - Lower Freeport	Clearfield, Pa.	2.68	53.7	58.2	67.2	73.9
1827 - Lower Freeport	Indiana, Pa.	2.16	58.9	61.1	63.9	69.4
1828 - Upper Freeport	Armstrong, Pa.	2.93	56.4	60.7	57.7	62.8
1829 - Lower Kittanning	Armstrong, Pa.	3.70	61.1	66.4	64.1	68.1
1830 - Upper Freeport	Armstrong, Pa.	2.25	59.7	61.9	64.4	64.4
1831 - Upper Clarion	Clarion, Pa.	2.54	52.1	54.3	58.7	58.7
1832 - No. 4-A	Jackson, Ohio	3.88	24.7	27.4	33.8	38.7
1833 - No. 7-A	Guernsey, Ohio	3.89	28.4	29.1	23.7	34.2
1834 - Upper Freeport	Clearfield, Pa.	3.48	40.8	56.2	67.2	74.7
1835 - No. 5	Muskingum, Ohio	5.36	64.5	75.4	76.9	78.4
1836 - Upper Kittanning	Cambria, Pa.	1.17	44.0	44.1	48.7	51.3
1837 - Upper Freeport	Cambria, Pa.	3.94	66.7	67.0	66.0	76.9
1838 - No. 6	Muskingum, Ohio	3.10	29.9	27.4	36.1	38.7
1839 - Middle Kittanning	Clearfield, Pa.	9.24	43.1	48.1	55.0	67.1
1840 - Lower Kittanning	Indiana, Pa.	3.54	55.4	58.5	63.3	70.1
1841 - Middle Kittanning	Clarion, Pa.	0.68	2.8	4.3	17.6	17.6
1842 - Lower Clarion	Clarion, Pa.	9.12	58.5	63.6	62.5	66.6



Bituminous Coal Research, Inc. 6070G12

Figure 4. Pyritic Sulfur Reduction at 1.60 Specific Gravity as Related to Nominal Topsize of Coal



Bituminous Coal Research, Inc. 6070G14

Figure 5. Total Sulfur Reduction at 1.60 Specific Gravity as Related to Nominal Topsize of Coal

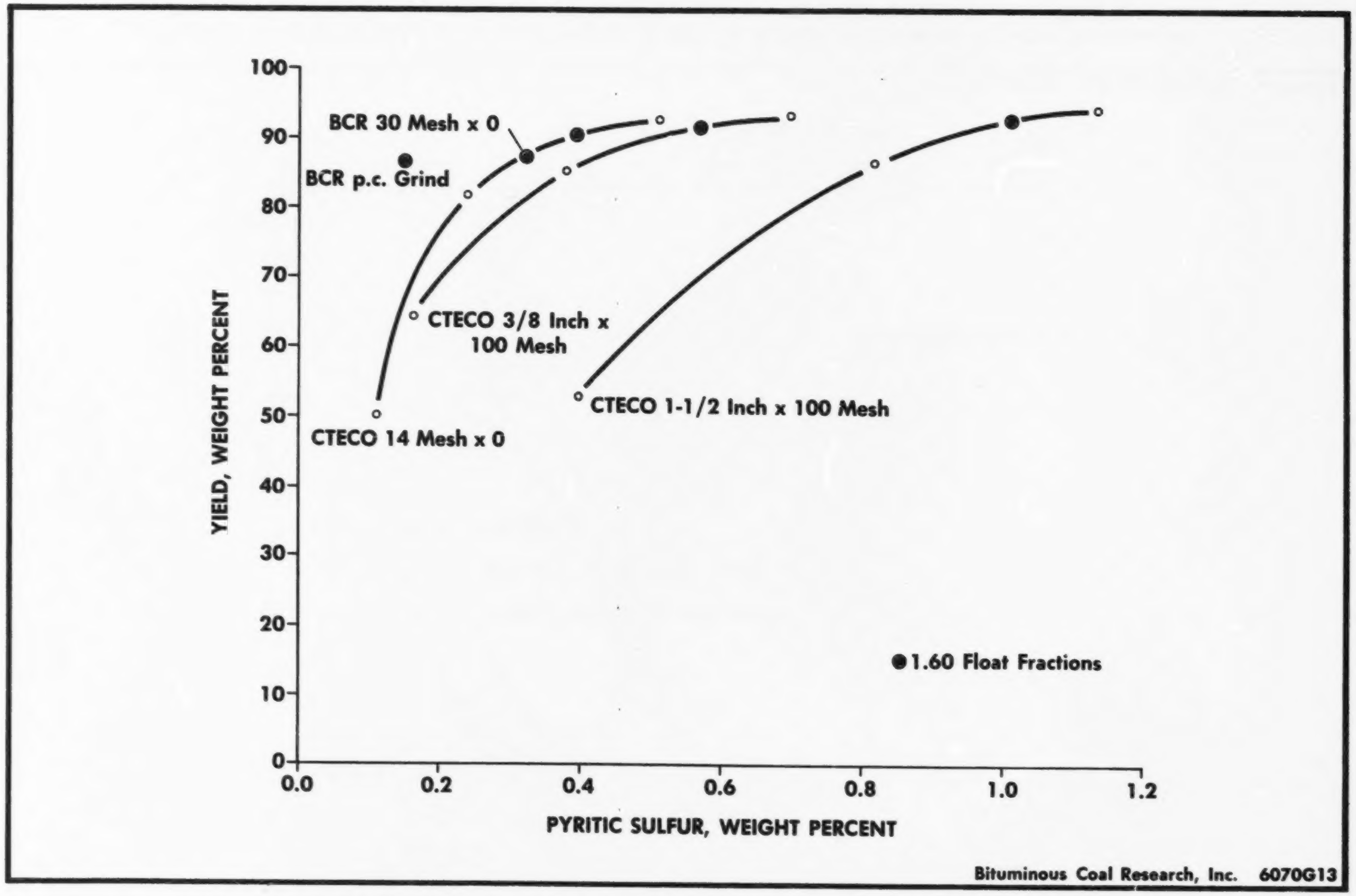


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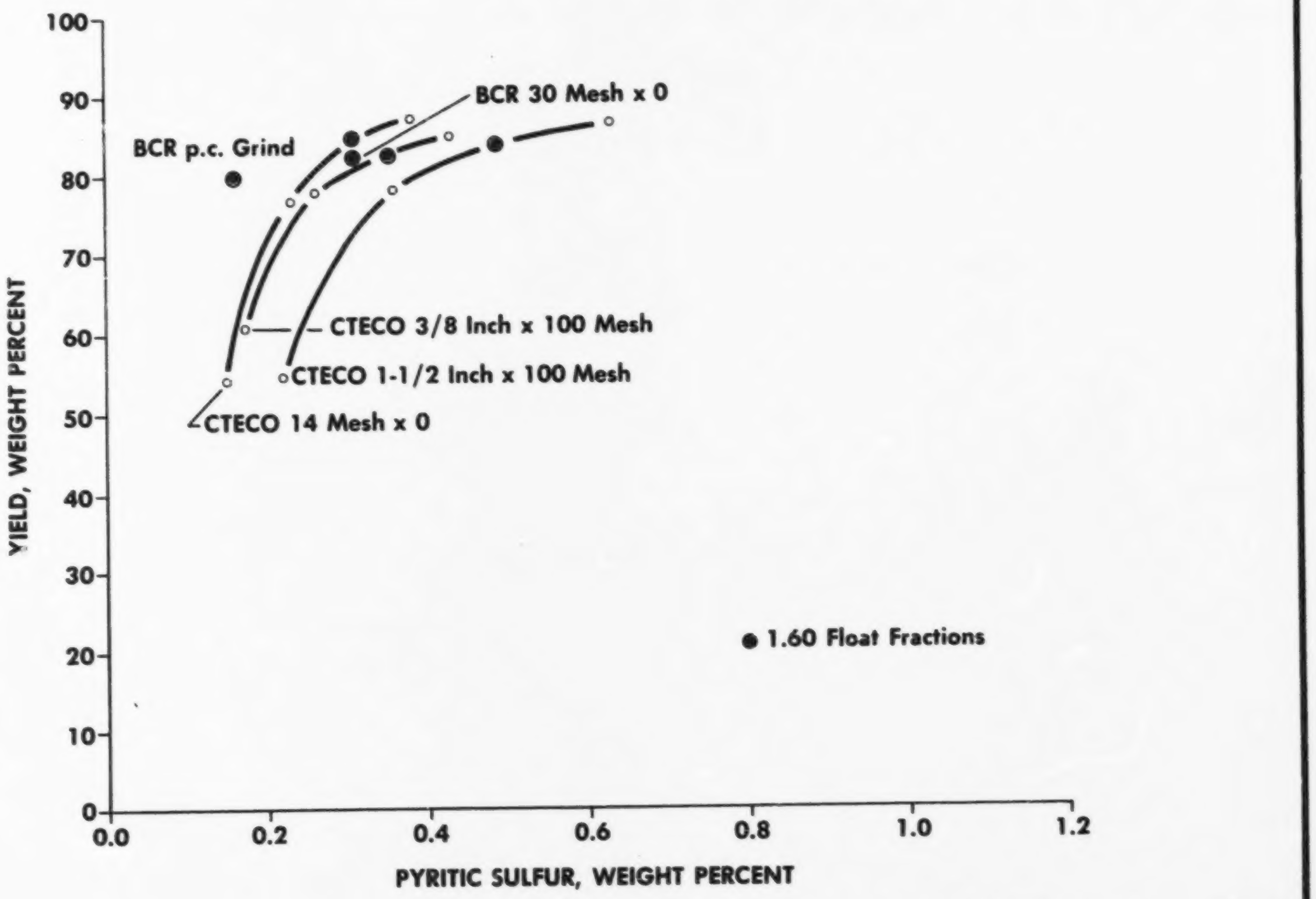
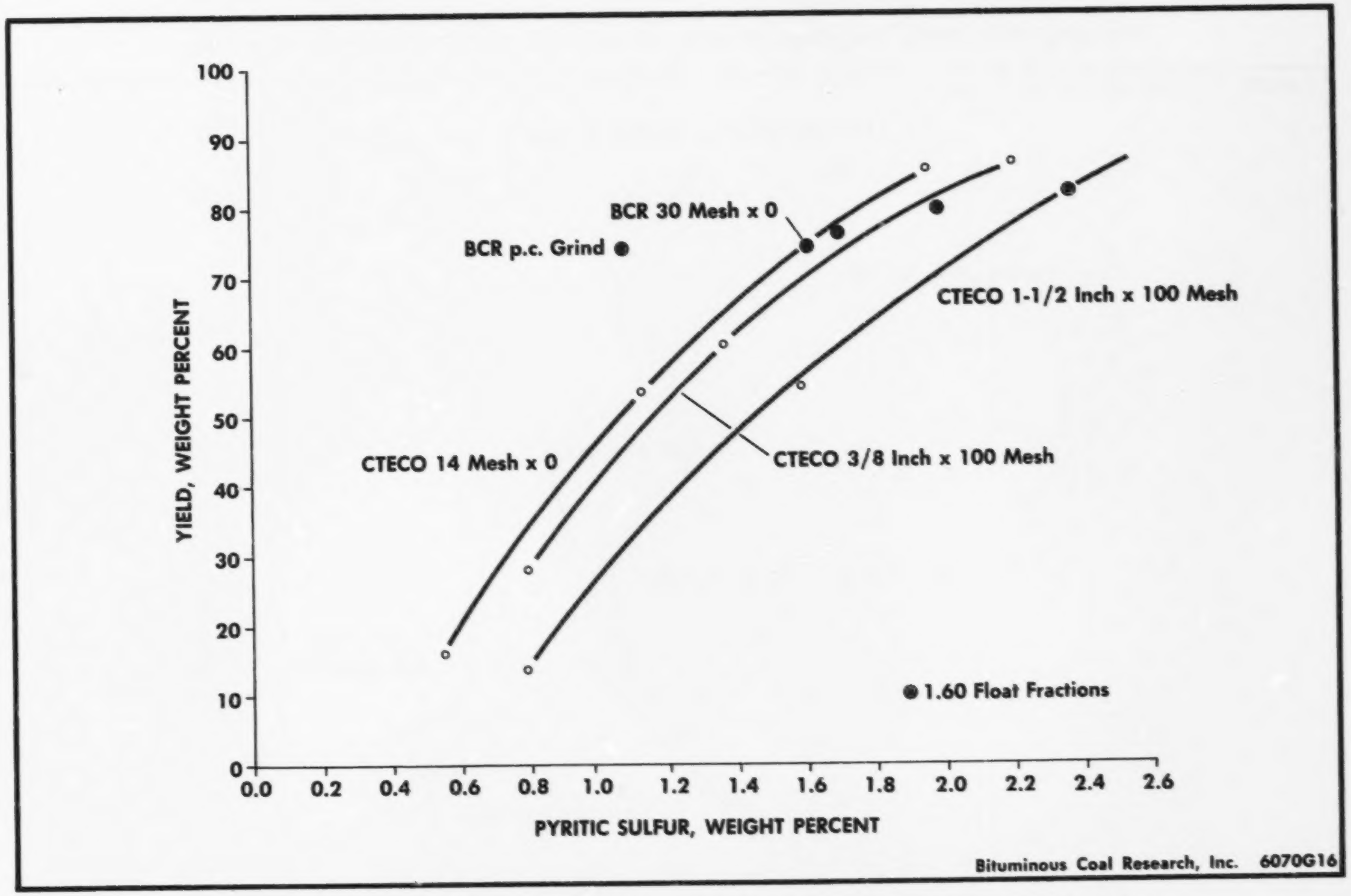
Figure 6. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Ohio No. 6-A Seam, Harrison County, Ohio (BCR 1735)



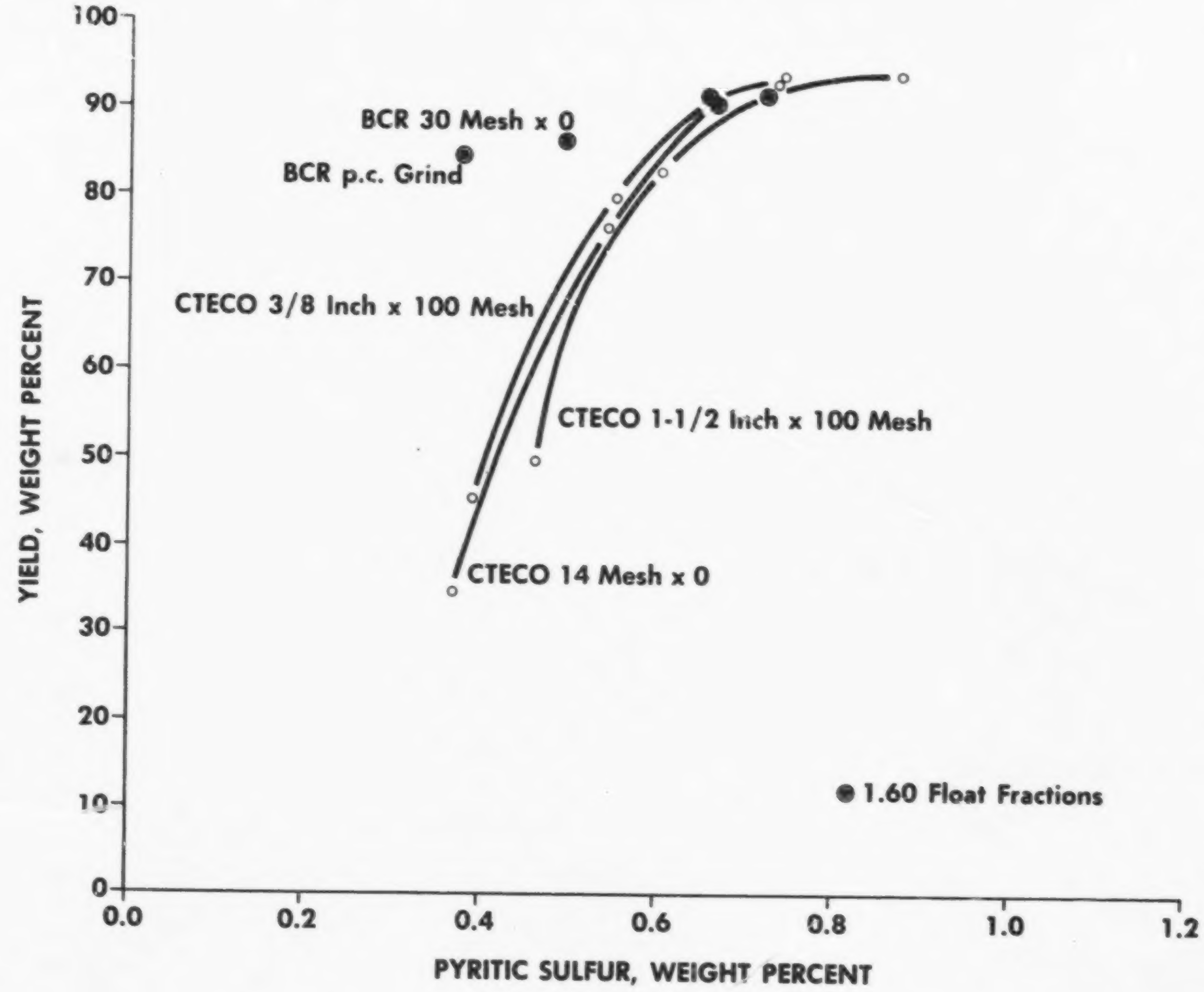
Bituminous Coal Research, Inc. 6070G15

Figure 7. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Lower Kittanning and Lower Freeport Seam, Cambria County, Pennsylvania (BCR 1747)



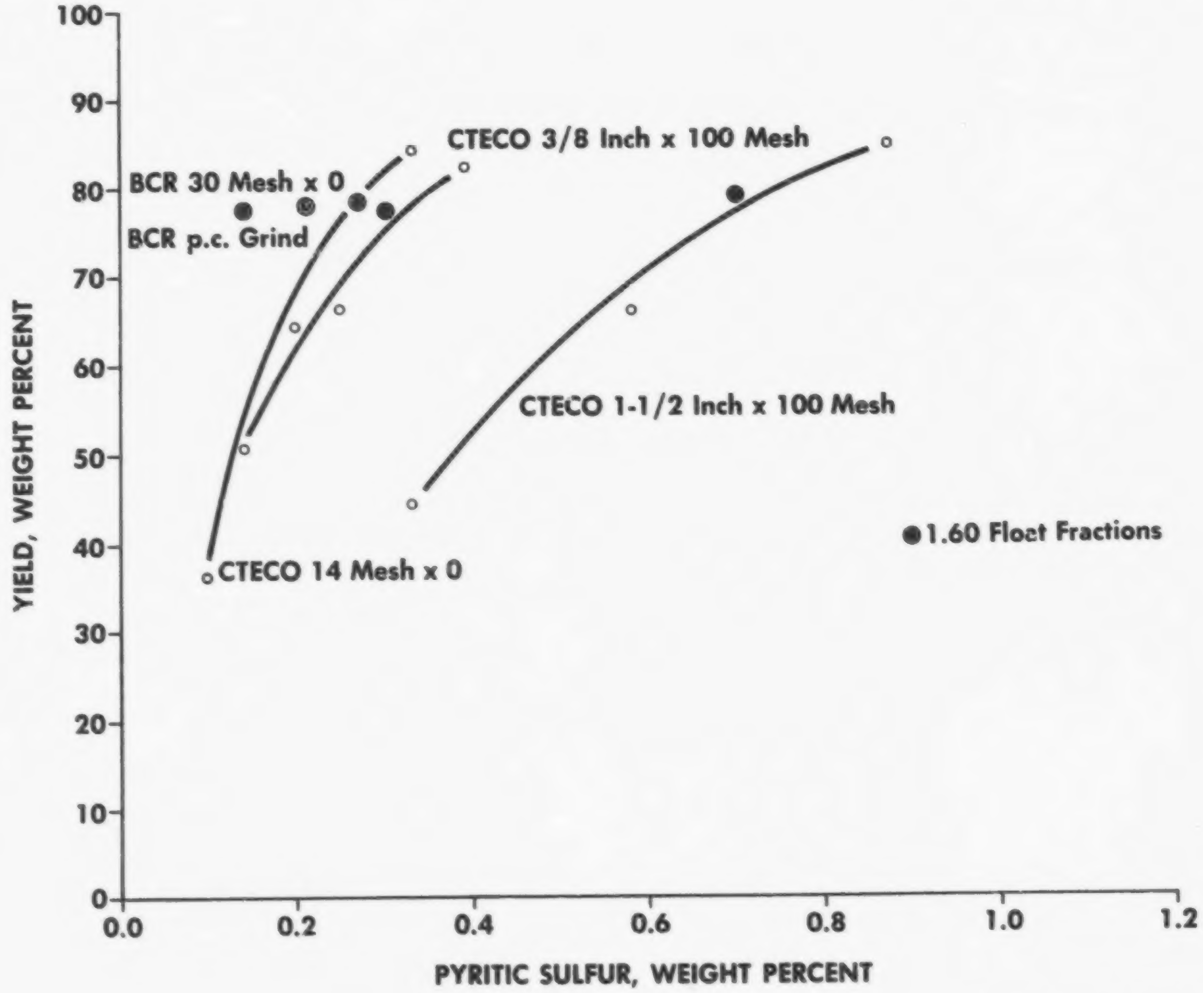
Bituminous Coal Research, Inc. 6070G16

Figure 8. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Ohio No. 8 Seam, Jefferson County, Ohio (BCR 1768)



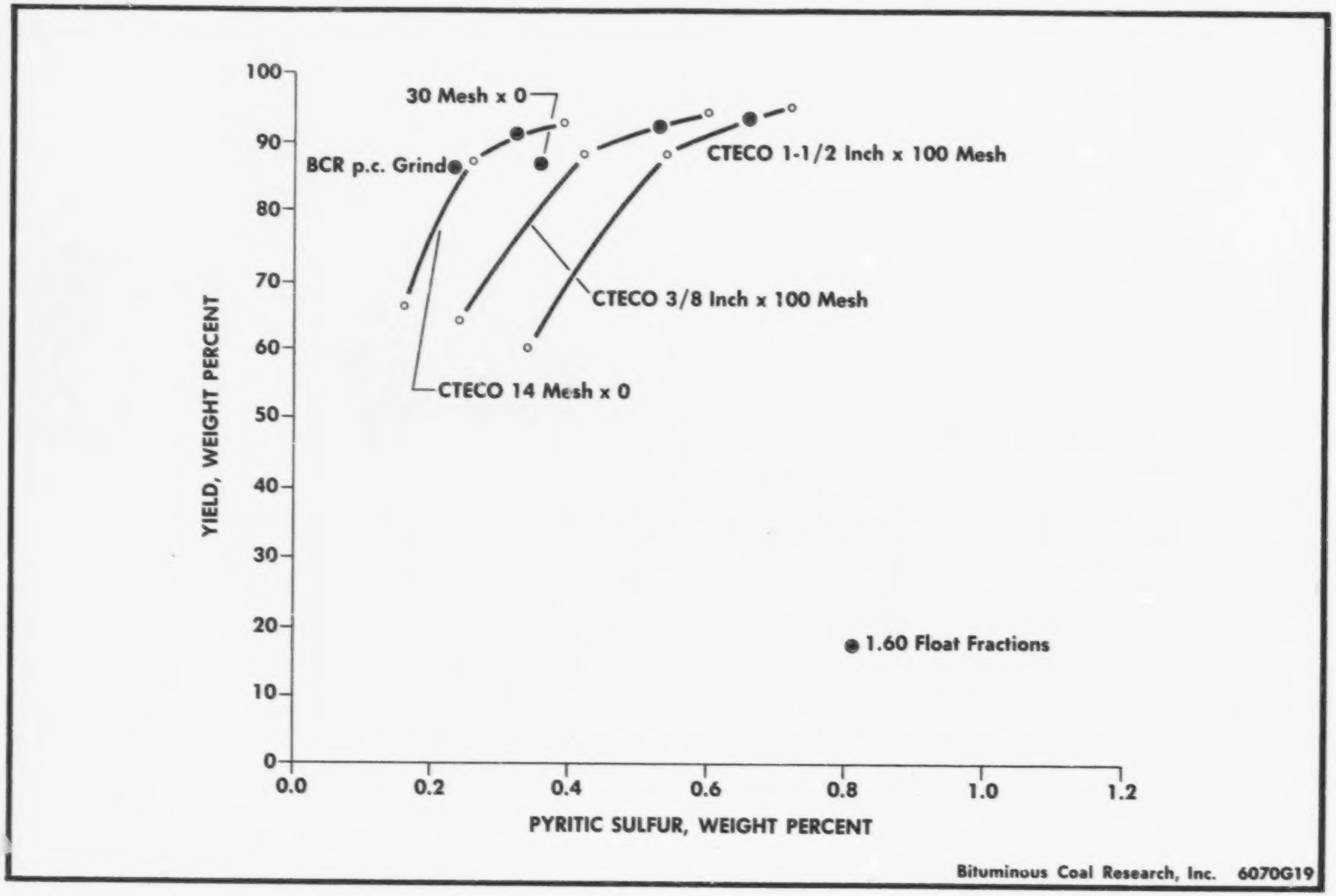
Bituminous Coal Research, Inc. 6070G17

Figure 9. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Illinois No. 5 Seam, Franklin County, Illinois (BCR 1795)



Bituminous Coal Research, Inc. 6070G18

Figure 10. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Lower Freeport Seam, Indiana County, Pennsylvania (BCR 1827)



Bituminous Coal Research, Inc. 6070G19

Figure 11. Pyritic Sulfur as Related to Yield at Nominal Topsize of Coal for Pittsburgh Seam, Marion County, W. Va., BCR Lot No. 1725 (CT-1)

seam coal. The same evaluation can be made for the Ohio No. 8 seam, Jefferson County, Ohio, shown in Figure 8.

Figure 9 indicates that there is little coarse pyrite in this Illinois No. 5 coal since there is relatively no pyritic sulfur reduction at a 1.60 specific gravity between the 1-1/2 inch topsize and the 14 mesh topsize. Somewhat significant reductions are obtained, however, at both the 30 mesh topsize and the p.c. grind. These data are in agreement with the findings of other research organizations who have shown that the majority of pyritic sulfur in Illinois coal occurs in the form of fine pyrite.

The opposite extreme of pyrite liberation and removal from the Illinois coal is in the Lower Freeport Seam from Indiana County, Pennsylvania, where most of the pyrite occurs as coarse pyrite and is removable at the 3/8 inch topsize. See Figure 10.

The final set of curves, Figure 11, is for the Pittsburgh Seam coal from Marion County, West Virginia, showing a step reduction of the pyritic sulfur content of the 1.60 float coal with the exception that either the 14 mesh topsize or the 30 mesh topsize is misplaced. The similarity in pyrite reduction between BCR's 30 mesh x 0 grind and Commercial Testing's 14 mesh x 0 grind was probably caused by the fact that the mean particle diameter of the two grinds was similar. The stage grinding procedure used by BCR on the 30 mesh x 0 raw coal would obviously produce a relatively large mean particle diameter. This could be equivalent to the mean particle diameter of a 14 mesh x 0 grind that had been produced by normal grinding techniques. The relative cleaning characteristics of the two grinds would, therefore, be similar.

Figures 6 through 11 exhibit some common characteristics. In general, a straight line can be drawn through the five points showing the 1.60 specific gravity separation for the five different size consists tested. There is, of course, some scattering of points around the straight line, but this could be caused by the fact that the Rosin-Rammler plots for the five sizes have dissimilar slopes. The sizing factor could be caused by many factors, including the method of preparing the sized fraction, or even the crushing and pulverizing equipment itself. It has been stated that the stage grinding used by BCR on the 30 mesh x 0 grind could place the sizing very close to some of Commercial Testing's 14 mesh x 0 grinds. It is also known that a hammer mill will prepare a completely different size consist than a jaw crusher with a given coal when crushing to a given topsize.

On the other hand, if we assume that the straight line drawn through the scattering of 1.60 gravity points is valid, we are inferring that there is some relationship in the size distribution of pyrite in any given coal. This is doubtful.

The slope of a line drawn through the points of 1.60 gravity separation does give a quick evaluation as to the relative difficulty or ease of pyritic sulfur reduction in terms of loss of recovery or yield of clean coal. The steeper the line, the greater the loss in recovery.

The removal of pyrite from coal should be effected by cleaning the coarsest size consist possible.

The cost of pulverizing coals to the minus 30 mesh and p.c. grinds, and subsequently effecting a gravity separation, is rather expensive. On the other hand, an increased yield of low sulfur coal could at least partially affect the cost of pulverization. A trade off between sulfur reduction and coal yield would have to be made by cleaning at a higher specific gravity than 1.60. If at least two additional points could be plotted for these two grinds, it might be possible to superimpose a set of isopyritic-sulfur curves on top of the other five curves and give the evaluator a much better feel for the economics of fine grinding and cleaning.

For example, at the moment we can tell for each coal, at the 30 mesh topsize and p.c. grind, how much additional material must be lost in order to obtain a single unselected pyritic sulfur reduction. It would be both interesting and helpful to know how much coal could be recovered at selected reductions in pyritic sulfur content within the range for each coal.

IV. PHASE II EVALUATIONS

A. Test Facility

A coal cleaning test plant was erected at Bituminous Coal Research, Inc., having a capacity of 2-1/2 to 3 tons per hour when cleaning 3/8 inch x 0 coal, and from 1 to 1-1/4 tons per hour when cleaning 30 mesh x 0 coal. The plant was designed around the initial fine coal cleaning device selected for testing, the concentrating table. Sufficient flexibility was designed into the plant to ensure that a variety of cleaning devices could be installed for testing at a later date.

The flow circuit for the 3/8 x 0 coal is shown in Figure 12. The raw coal is fed from the raw coal hopper by a vibrating feeder onto a portable elevating conveyor which discharges the coal into a surge hopper. A double flight, variable speed screw feeder discharges this dry coal into a wetting sluice. The water is introduced into the wetting sluice, countercurrent to the resulting slurry flow, through nine spray nozzles in order to obtain the turbulence required for thoroughly wetting the coal. Additional water that has been treated with a solid, low-foam, wetting agent is introduced into the pump sump. The water from a constant head tank is metered through a micrometer-type valve so that the resulting slurry is in the proper solids-to-liquid ratio for (1) pumping to the feedbox of the concentrating table, and (2) tabling.

The 3/8 x 0 refuse from the table is sluiced to a refuse tank where it is accumulated. The clean coal is passed across a vibrating dewatering screen equipped with a tapered-slot wedge wire screen. The dewatered oversize, or plus 30 mesh material, is discharged onto a belt conveyor. The undersize is pumped to a clarifying cyclone and the thickened underflow is discharged into a disc filter for dewatering. The filter cake is discharged on top of the dewatered coarse coal on the belt conveyor. The combined product is discharged into two 2-1/2 ton-capacity stainless steel storage bins.

Figure 13 shows the flow diagram for the 30 mesh x 0 circuit. All of the components are the same as the 3/8 inch x 0 circuit, with the exception of the coal feeding and wetting system. The 30 mesh x 0 circuit employs a surge hopper, vibrating feeder, agitator, and pump. The coal, water, and wetting agent are all added to the agitator for complete mixing and wetting of the coal. The use of the dewatering screen and clarifying cyclone with the 30 mesh cleaning is optional.

B. Concentrating Table

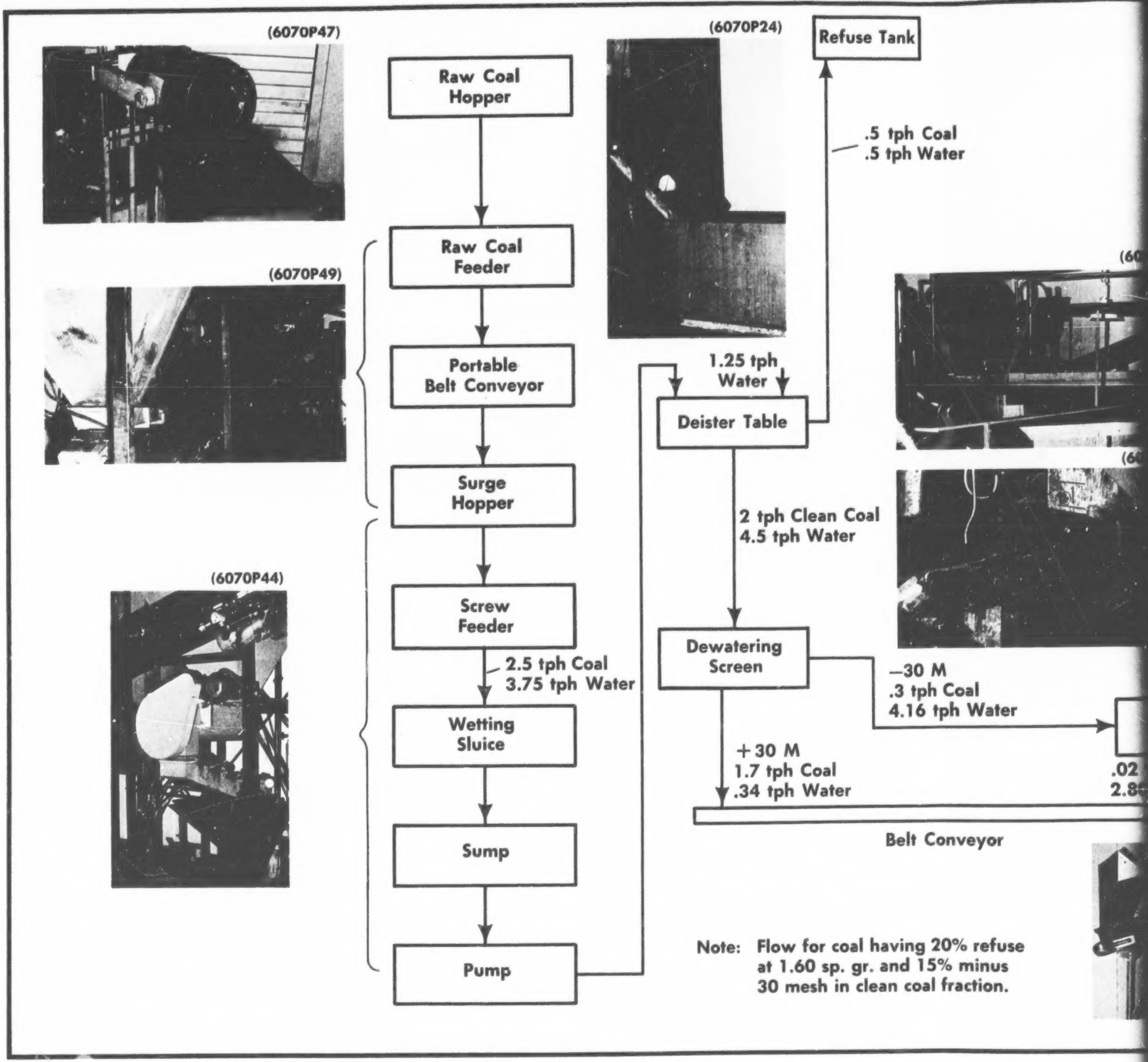
1. Description and Theory of Operation

One of the better descriptions of the concentrating table (Figure 30) can be found in the Bureau of Mines RI 6239 entitled "Performance Characteristics of Coal Washing Equipment: Concentrating Tables" by

A. W. Deurbrouck and E. R. Palowitch.

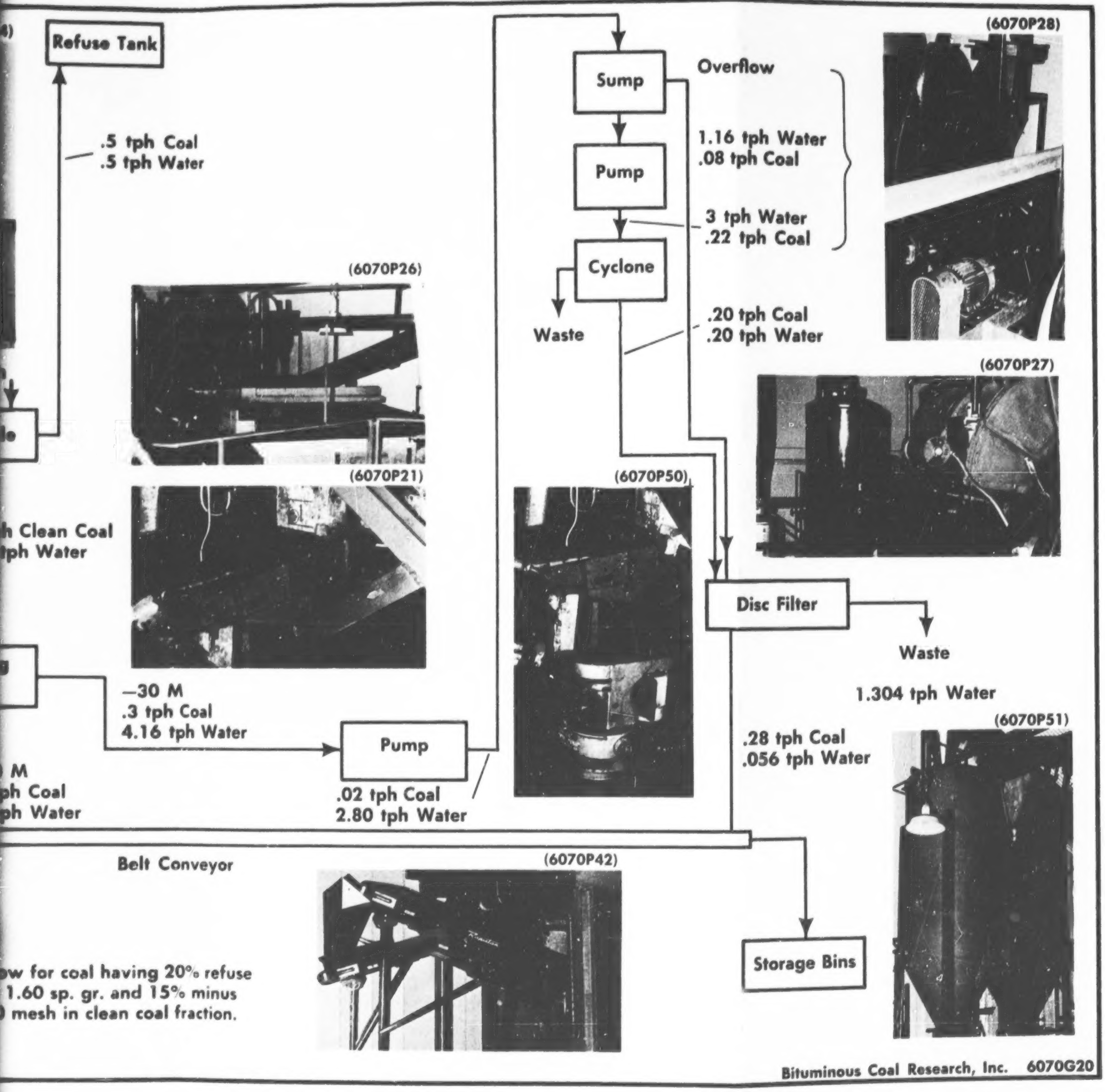
While their description, which follows, is made on a full-sized commercial deck with a feed rate of between 10 to 12 tons per hour, the description and theory of operation also applies to the quarter-size deck with a capacity of between 2.5 to 3 tons per hour utilized in this program.

> The table employs the principle of flowing a mixture of coal and water over a series of riffles which are shaken rapidly to effect a separation of the coal by particle size and specific gravity. Essentially the table consists of a pair of steel channels upon which is mounted a rubber-covered deck and a drive mechanism.
>
> The flat, rhomboid-shaped deck is approximately 17 feet long on the clean-coal side and 8 feet wide on the refuse side. It is supported in an essentially horizontal plane, but slopes enough (perpendicular to the motion of the deck) so that water fed along the upper long side will flow across the table surface and discharge along the lower clean-coal side. The deck is attached to a differential-motion drive which gives it a quick-return conveying motion, moving material lying on the table surface away from the drive end. The frequency and amplitude of stroke and the transverse slope are adjusted to suit the material being treated.
>
> Attached to the rubber covering on the deck is a system of rubber riffles tapering toward the refuse end of the table and parallel to the direction of the conveying motion. Standard body riffles are approximately 1/4 inch high at the drive end of the table. Between each set of three or four body riffles are high (over 1 inch at the drive end) "pool" riffles. These riffles form dams, behind which stratification of the bed occurs. Low-density particles ride over the riffles, reporting to the clean-coal side of the table; high-density particles are carried behind the riffles by the differential-motion drive to the refuse end of the table.
>
> At one corner of the long diagonal and above the deck is a feedbox with a slotted bottom to spread the feed onto the deck. Beside the feedbox and along that side of the deck is a trough, having adjustable gates through which the flow of dressing water to the deck is distributed.
>
> The cross slope of the table is varied by a handwheel through a rack-and-pinion to a pair of wedges beneath the deck which are on opposite sides of the axis of the table.
>
> Because of the reciprocating action of the table and the transverse flow of water, the pulp fans out immediately upon contacting the table surface. The upward slope of the table toward the refuse end, usually 1/8 to 1/4 inch per foot, and the retaining effect of


(6070P47)
(6070P49)
(6070P44)
(6070P24)
Raw Coal Hopper
Raw Coal Feeder
Portable Belt Conveyor
Surge Hopper
Screw Feeder
2.5 tph Coal
3.75 tph Water
Wetting Sluice
Sump
Pump
Refuse Tank
.5 tph Coal
.5 tph Water
1.25 tph Water
Deister Table
2 tph Clean Coal
4.5 tph Water
Dewatering Screen
−30 M
.3 tph Coal
4.16 tph Water
+30 M
1.7 tph Coal
.34 tph Water
Belt Conveyor
.02
2.8
(60
(6

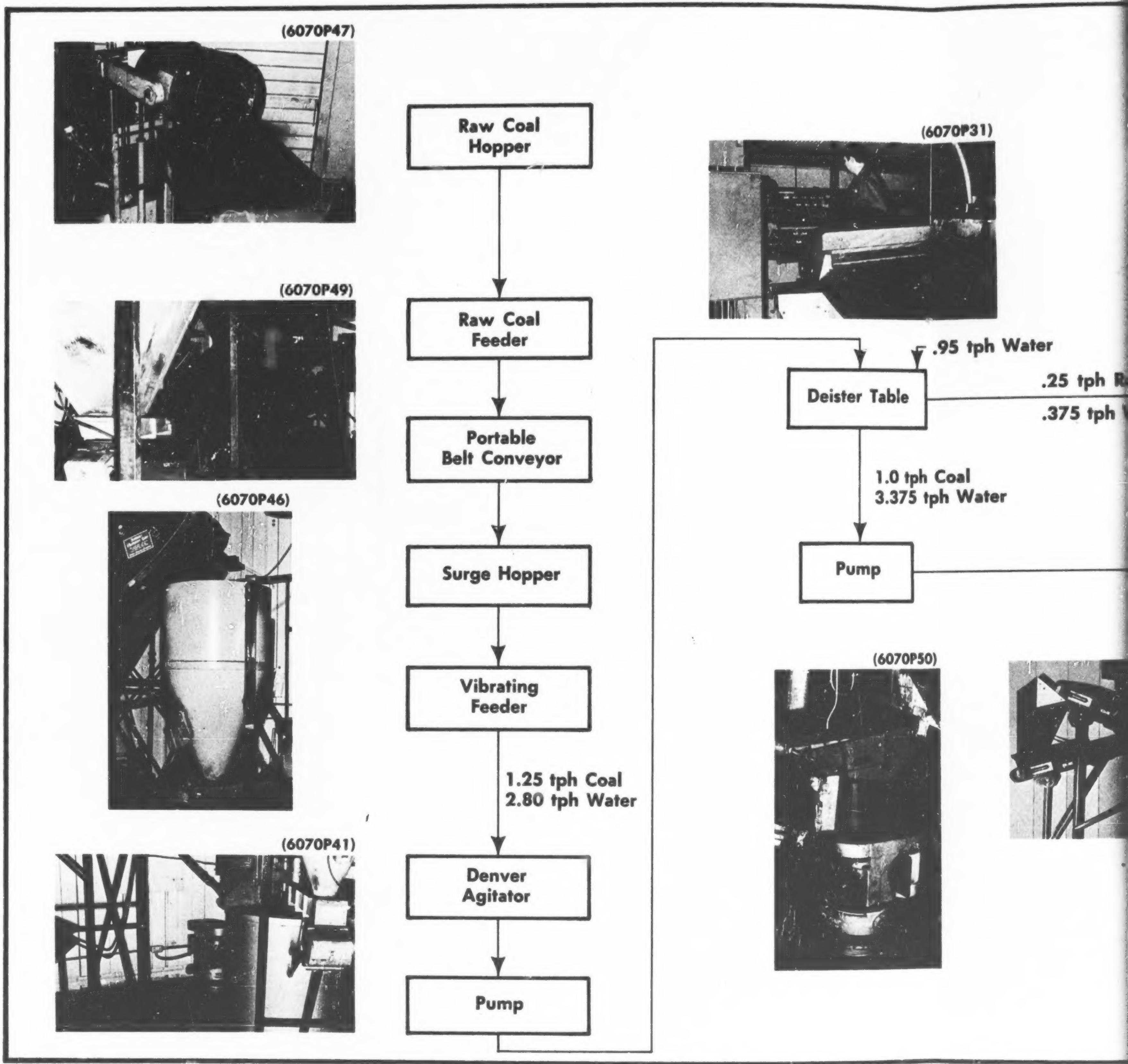
Note: Flow for coal having 20% refuse at 1.60 sp. gr. and 15% minus 30 mesh in clean coal fraction.

Figure 12. Schematic Flow Sheet for Concentrating Table Tests


4)
Refuse Tank
.5 tph Coal
.5 tph Water
(6070P26)
le
(6070P21)
h Clean Coal
tph Water
g
—30 M
.3 tph Coal
4.16 tph Water
Pump
.02 tph Coal
2.80 tph Water
0 M
ph Coal
ph Water
Belt Conveyor
(6070P42)
ow for coal having 20% refuse
1.60 sp. gr. and 15% minus
0 mesh in clean coal fraction.
Sump
Overflow
Pump
1.16 tph Water
.08 tph Coal
3 tph Water
.22 tph Coal
Cyclone
Waste
.20 tph Coal
.20 tph Water
(6070P28)
(6070P27)
(6070P50)
Disc Filter
Waste
1.304 tph Water
.28 tph Coal
.056 tph Water
(6070P51)
Storage Bins
Bituminous Coal Research, Inc. 6070G20

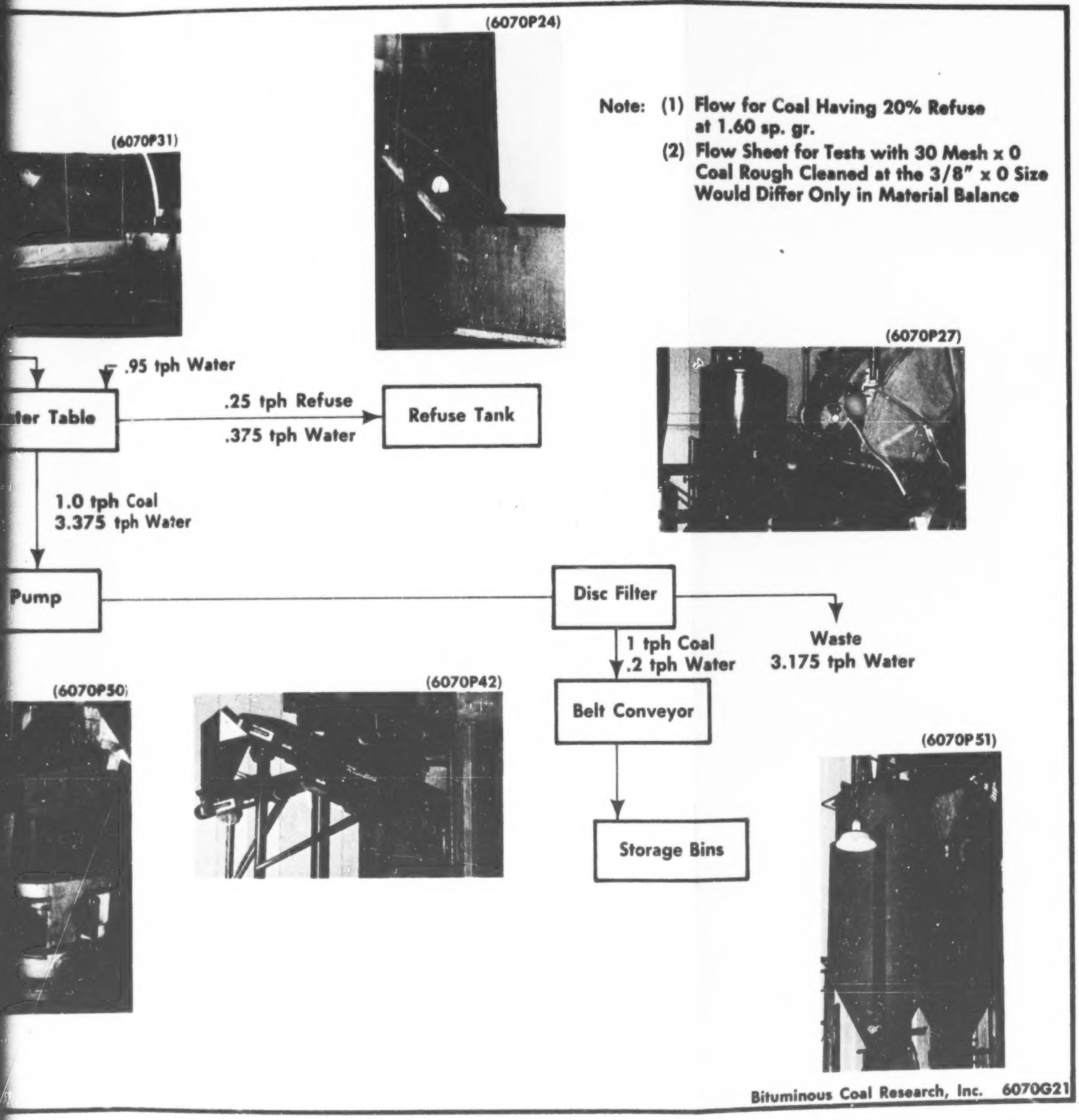
eet for Concentrating Table Tests with 3/8 Inch x 0 Raw Coal

B


(6070P47)
(6070P49)
(6070P46)
(6070P41)
Raw Coal Hopper
Raw Coal Feeder
Portable Belt Conveyor
Surge Hopper
Vibrating Feeder
1.25 tph Coal
2.80 tph Water
Denver Agitator
Pump
(6070P31)
.95 tph Water
Deister Table
.25 tph R
.375 tph
1.0 tph Coal
3.375 tph Water
Pump
(6070P50)

A

Figure 13. Flow Sheet for Concentrating Table Tests with



(6070P24)
(6070P31)
(6070P27)
(6070P50)
(6070P42)
(6070P51)
.95 tph Water
ter Table
.25 tph Refuse
.375 tph Water
Refuse Tank
1.0 tph Coal
3.375 tph Water
Pump
Disc Filter
1 tph Coal
.2 tph Water
Waste
3.175 tph Water
Belt Conveyor
Storage Bins

Note: (1) Flow for Coal Having 20% Refuse at 1.60 sp. gr.
(2) Flow Sheet for Tests with 30 Mesh x 0 Coal Rough Cleaned at the 3/8" x 0 Size Would Differ Only in Material Balance

Bituminous Coal Research, Inc. 6070G21

ncentrating Table Tests with 30 Mesh x 0 Raw Coal

B

the pool riffles cause the pulp to form a pool near the feedbox. This area, in which the bed of material is several particles deep and substantially above the standard riffles, is the zone of primary stratification. In this zone the shaking motion of the deck combined with the cross current of water stratifies the particles by density, similar to the action of a jig washer.

A comprehensive study of the fundamentals of table operation is given by Bird.(1) Zimmerman (2) describes the separation on a concentrating table as follows:

> "Since stratification and separation of particles are not complete as a result of any one riffle, a series of riffles are used, repeating the cycle of stratification and hindered settling from riffle to riffle, obtaining purer products as the particles fan out and progress forward and downward over the table.
>
> "The smallest heaviest particles stratify themselves downward to the surface of the deck more quickly and are carried out by table movement toward the refuse end at a faster rate than coarse heavy particles. Light-gravity larger pieces ride on the top layer of particles and flow on down the slope of the deck as a result of the coarse flow of wash water at right angles to the shaking movement of the table. Heavy large particles settle down next to the fine heavy particles and are carried behind the riffles towards the longitudinal end but do not ride as high up the table as the heavy fine particles.
>
> "There is a tendency for the fine or small size light-gravity particles to lie between the coarse heavy particles and work over into the zone with the coarse refuse, and if the only separating action on a table were that of straight stratification, this would result in fine coal getting over into the refuse. Fortunately, however, hydraulic classification occurs under settling conditions which tends to counteract this and by proper use of water dilution and wash water as well as riffle design the small light particles of coal are washed off with coarse light particles or coarse coal."

---

1. Bird, B. M. The Sizing Action of A Coal-Washing Table. BuMines Rept. of Inv. 2755, 1926, 18 pp.

   Bird, B. M., and H. S. Davis. The Role of Stratification in the Separation of Coal and Refuse on A Coal-Washing Table. BuMines Rept. of Inv. 2950, 1929, 19 pp.

2. Zimmerman, R. E. The Cleaning of Fine Sizes of Bituminous Coal by Concentrating Tables. Trans. AIME, vol. 187, 1950.

Successive samples collected along the side and end of the table, starting at the head-motion end, show a steady increase in ash content and a steady decrease in the average particle size for each individual specific-gravity fraction.

The concentrating table was divided into the following five sampling zones as shown in Figure 14: Zone A for ultra clean coal, Zone B for clean coal, Zone C for high ash coal, Zone D for refuse, and Zone E for pyrite. In addition to the adjustable division shown between the pyrite and refuse zones (Zones E and D), provisions were made so that a black and white separation could be effected by bringing the high carbon refuse from Zone D back around the corner of the table into Zone C. This black and white separation is also referred to as a rough cleaning operation since only the obvious impurities are removed from the R.O.M. coal. An electropneumatic sampling system, Figure 15, was set up so that samples could be automatically obtained once stable and desired operating conditions had been established. Figure 16 shows the control panel for the cleaning plant; Figure 17, the floor sump for general cleanup; and Figure 18, the pressure filter for dewatering the samples.

2. Test Procedure

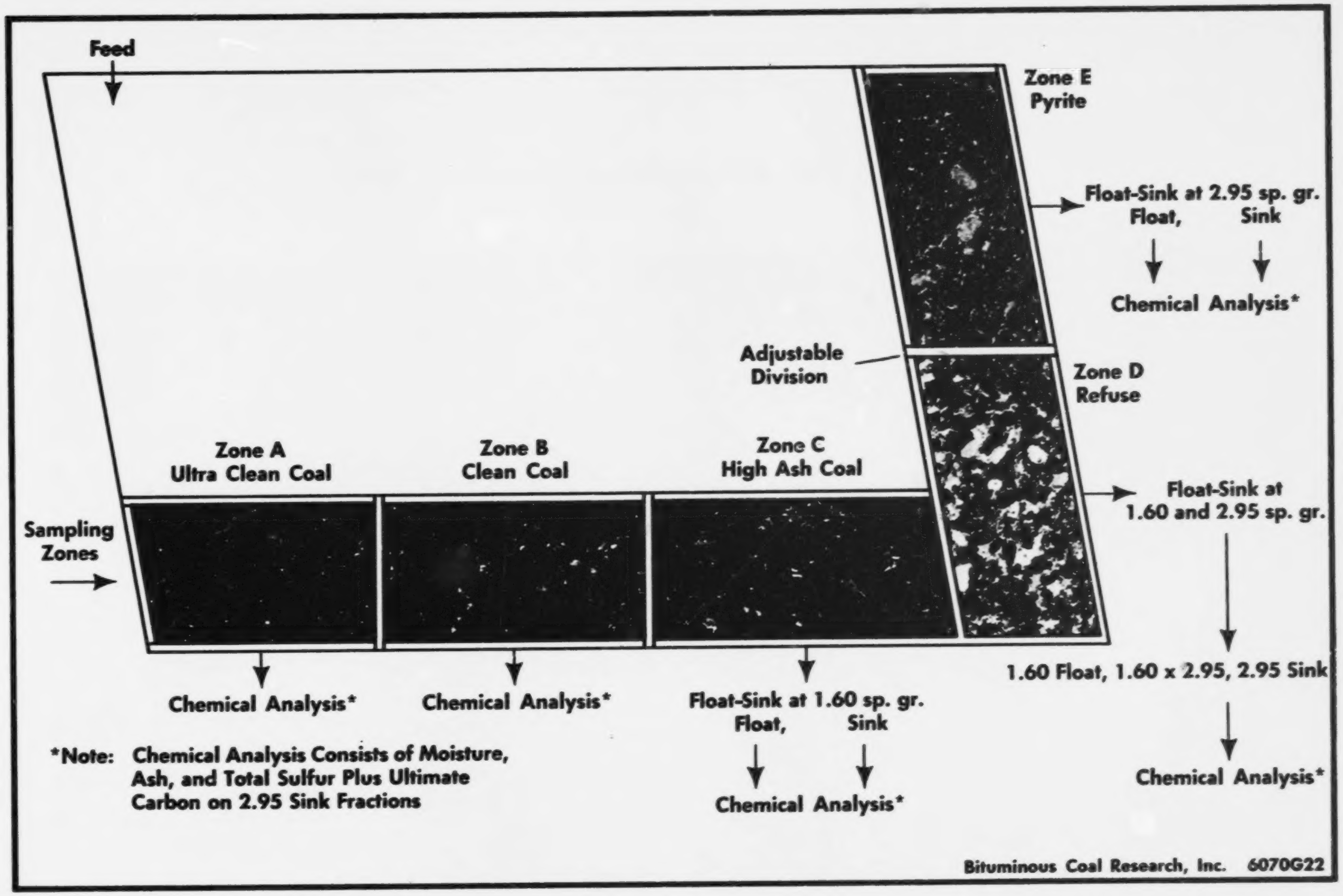
As previously mentioned, of the seventy coals analyzed during the course of the program, six were chosen for table tests based on pyritic sulfur removal when reduced to minus 30 mesh in size and cleaned at 1.60 specific gravity. Table 6 shows the chemical data for these six coals. Since only total sulfur analyses were obtained on the various samples from the concentrating table runs, the data are presented to give a general idea of the organic sulfur content of the coals subsequently tested.

The 3/8 inch x 0 size consist was prepared by passing the R.O.M. coal through a Jeffrey Hammer Mill, shown in Figure 19. The oversize was screened out, recrushed, and remixed into the total sample. Large pieces of slate were crushed in a jaw crusher and also remixed into the sample after it had been reduced to minus 3/8 inch in size.

The 30 mesh x 0 grinds were prepared by single-stage pulverization in a Pulva-Sizer Hammer Mill. Both the jaw crusher and the Pulva-Sizer Hammer Mill are shown in Figure 20.

When the 3/8 inch x 0 runs were conducted so as to obtain a black and white separation (rough cleaning), the coal fraction was accumulated in the storage bins, allowed to further dewater or dry for several days, and then pulverized to a topsize of 30 mesh for second-stage cleaning.

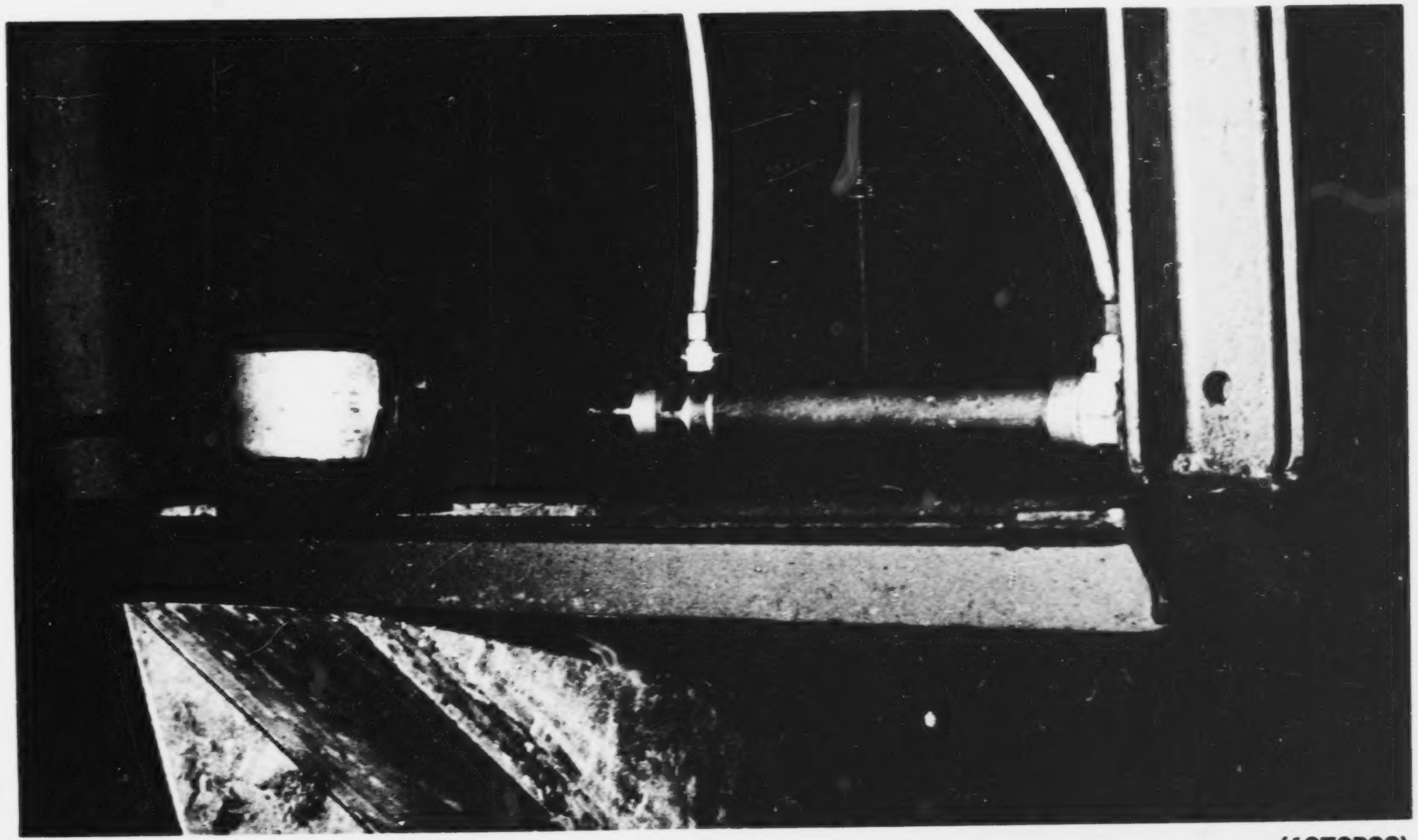
The sampling period of the automatic sampling device previously described was adjustable between 0 and 60 seconds with the increment being every minute or multiple thereof. In actual practice, a 10-second sampling period every two minutes was found satisfactory for a 15-minute test run.


Feed
Zone E
Pyrite
Float-Sink at 2.95 sp. gr.
Float,
Sink
Chemical Analysis*
Adjustable
Division
Zone D
Refuse
Zone A
Ultra Clean Coal
Zone B
Clean Coal
Zone C
High Ash Coal
Float-Sink at
1.60 and 2.95 sp. gr.
Sampling
Zones
1.60 Float, 1.60 x 2.95, 2.95 Sink
Chemical Analysis*
Chemical Analysis*
Float-Sink at 1.60 sp. gr.
Float,
Sink
Chemical Analysis*
Chemical Analysis*

*Note: Chemical Analysis Consists of Moisture, Ash, and Total Sulfur Plus Ultimate Carbon on 2.95 Sink Fractions

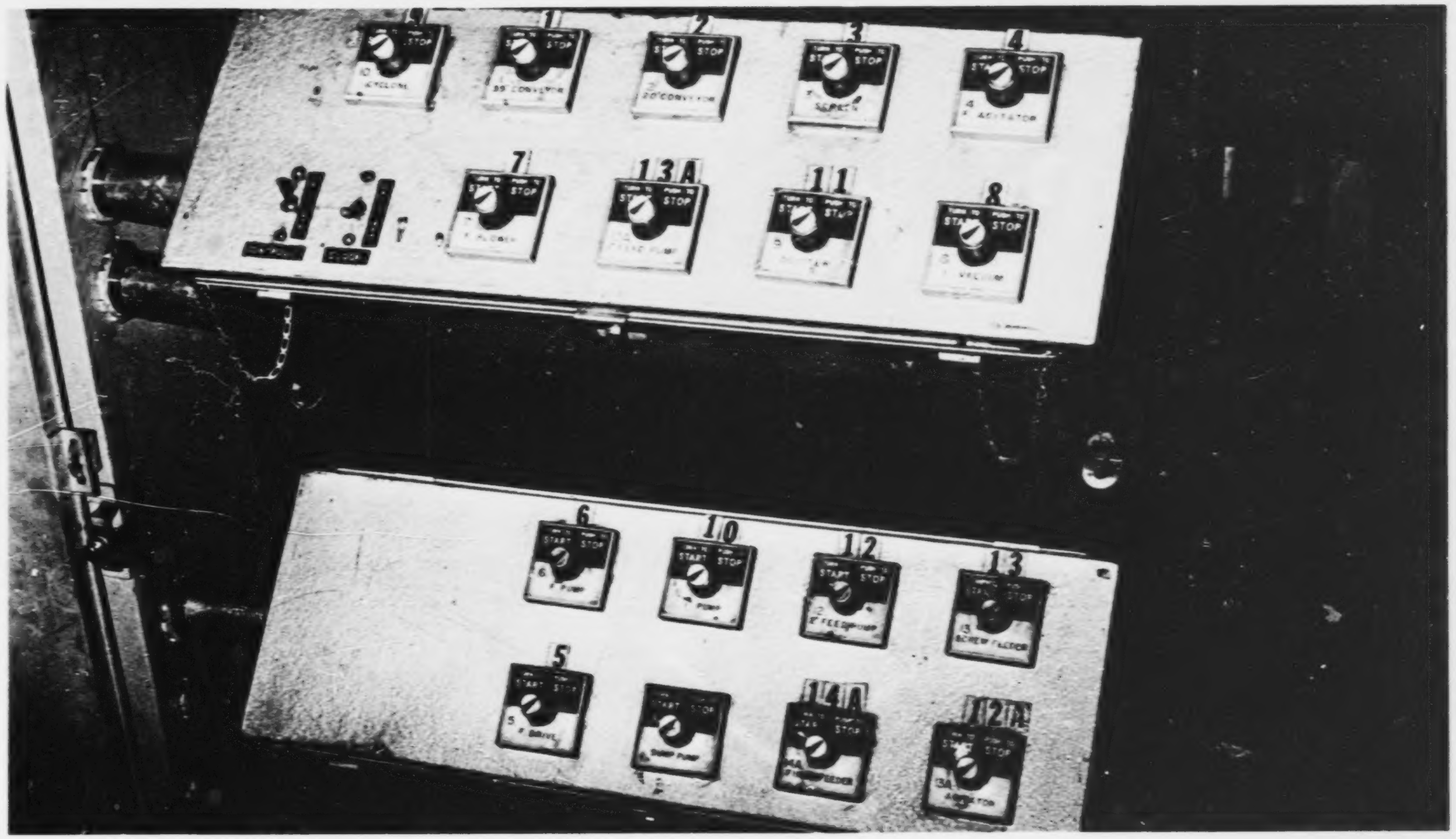
Bituminous Coal Research, Inc. 6070G22

Figure 14. Sampling Flow Sheet for Concentrating Table Tests



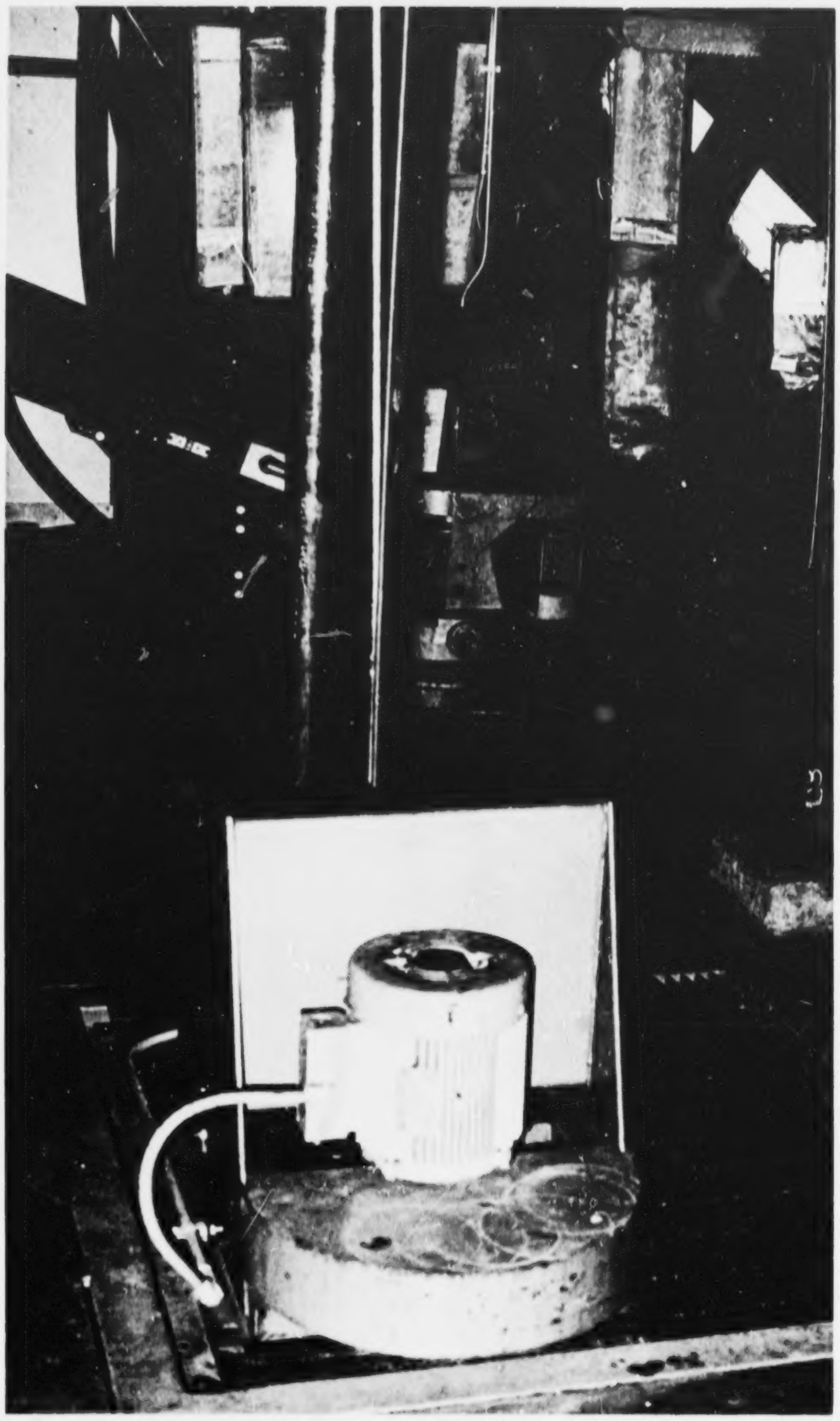
(6070P22)

Figure 15. Automatic Electro-Pneumatic Sampling Device


1
2
3
4
7
13A
11
8
START STOP
6
10
12
13
5
14A
12A

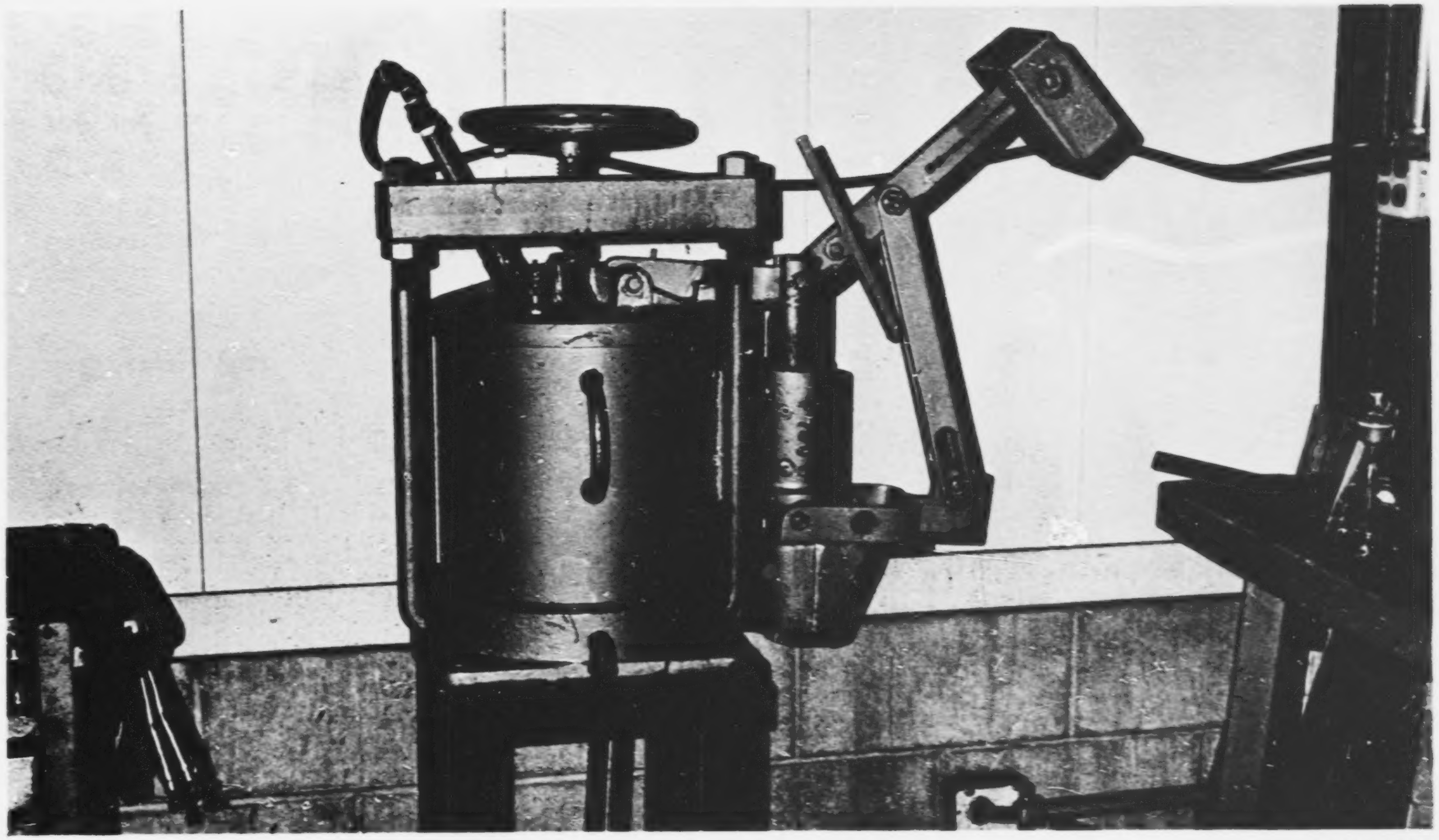
(6070P33)

Figure 16. Operation Control Panel and Product Sampling for Concentrating Table Cleaning Systems



(6070P48)

Figure 17. Sump Pump Used for General Clean-up of Wet Preparation Area

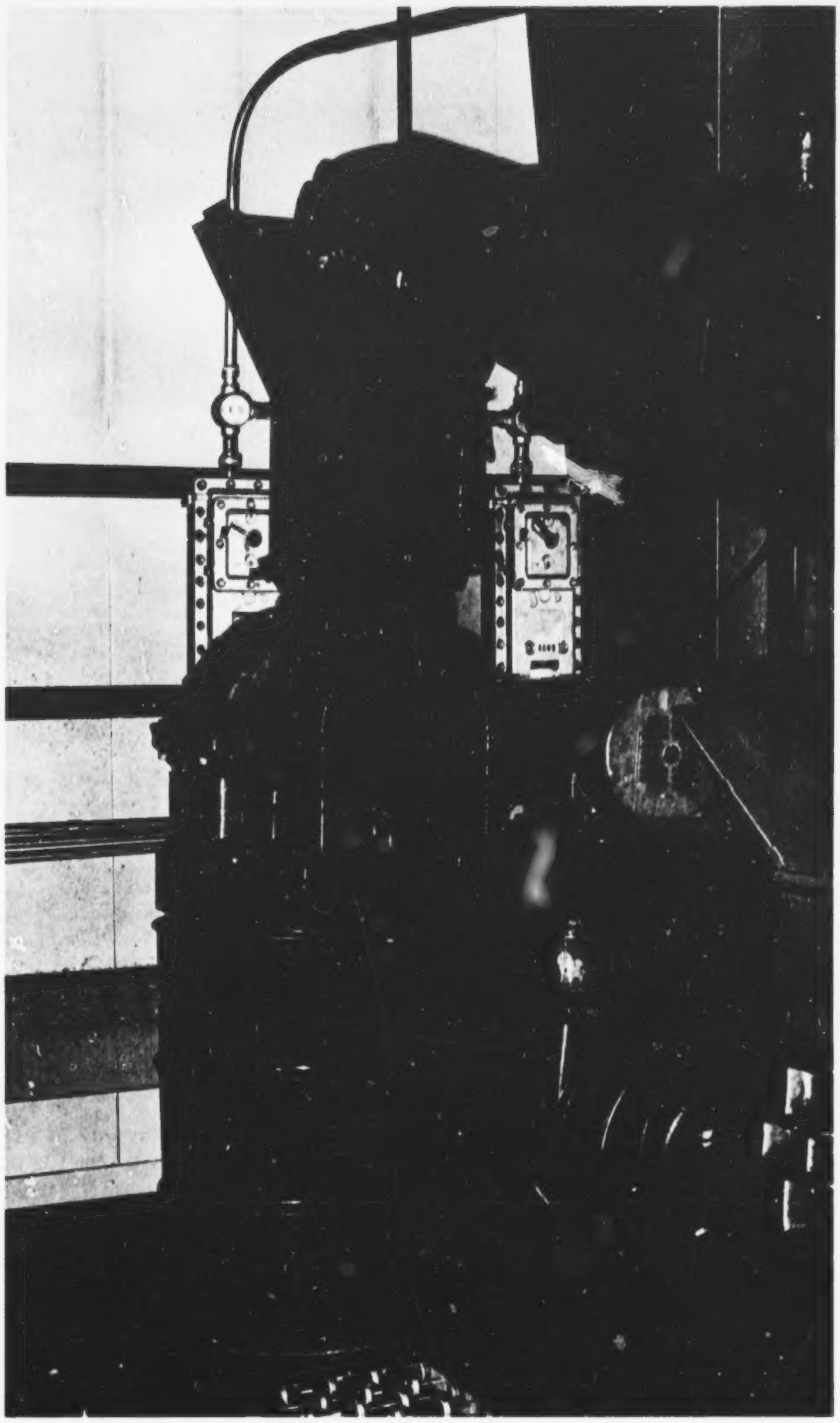


(6070P43)

Figure 18. Denver Pressure Filter for Dewatering Samples

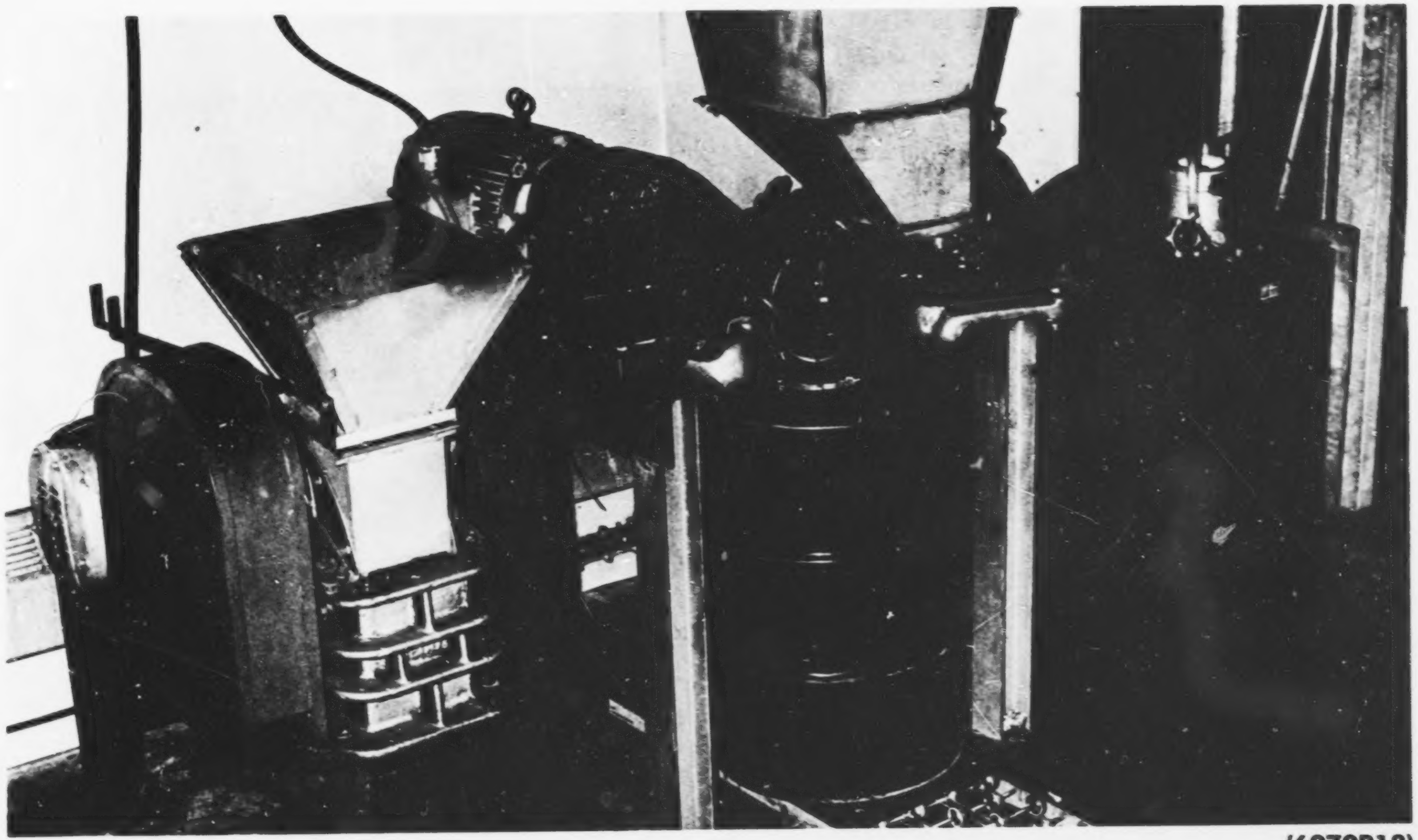
TABLE 6. ANALYSES OF COALS SELECTED FOR CONCENTRATING TABLE TESTS

Coal Identification Seam County, State	BCR Lot No.	Weight Percent, Dry Basis					Organic Sulfur as Percent of Total Sulfur
		Ash	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	
Lower Freeport Armstrong, Pa.	1771	12.8	2.54	0.00	1.89	0.65	25.6
No. 6-A Harrison, Ohio	1735	10.4	2.50	0.01	1.86	0.63	25.2
Upper Freeport Westmoreland, Pa.	1750	22.5	3.74	0.03	3.22	0.49	13.1
No. 8 Jefferson, Ohio	1768	19.4	4.71	0.07	3.69	0.95	20.2
No. 6 Columbiana, Ohio	1745	10.4	2.44	0.05	1.79	0.60	24.6
Lower Kittanning Indiana, Pa.	1755	20.1	4.66	0.05	4.00	0.61	13.1



(6070P17)

Figure 19. Jeffrey Hammer Mill



(6070P18)

Figure 20. Denver Jaw Crusher and Pulva-Sizer Hammer Mill

The analyses obtained on the five zone samples are also shown in Figure 14. The coal obtained from the two clean coal zones was assumed to be 100 percent 1.60 float material. A 1.60 specific gravity separation was made on the high ash coal from Zone C for two reasons. In the conventional 3/8 inch x 0 runs and in all the 30 mesh x 0 runs it was necessary to know the quantity of misplaced material (1.60 sink) present in the high ash clean coal zone, as an indicator of efficiency. With the black and white separations, it was possible to ascertain the potential 1.60 table separation by compositing the analyses of Zones A and B with the 1.60 float material from Zone C. Zone D material, primarily high ash coal and/or shale, was subjected to float-sink analyses at 1.60 and 2.95 specific gravity in order to determine the misplaced 1.60 float material from Zone C (coal) and misplaced 2.95 sink material from Zone E (pyrite). The pyrite zone, Zone E, was subjected to gravity separation at a 2.95 specific gravity to determine the misplaced float material (shale) from Zone D.

In addition to these samples, a feed sample was taken for all of the runs. A screen analysis was made on one split of the sample. The screen analyses for the 3/8 inch x 0 R.O.M. coal are shown in Table 7 while the 30 mesh x 0 screen analyses are shown in Table 8. Chemical analyses were obtained on a second split of the feed samples. The chemical analyses of the feed samples were then compared to the weighted composite of the chemical analyses of all of the fractions obtained from the table as shown in Figure 14. Table 9 shows, for single-stage cleaning, the zones and the number of fractions utilized to obtain the various composites contained in Appendix B, Tables B-1 to B-19. When two-stage cleaning was performed, the weighted composite obtained for the feed material was compiled by combining the chemical data of the discarded material (white fraction) from the 3/8 inch x 0 roughcleaning run, with the data of the fractions produced by recleaning the coal fraction after it had been pulverized to 30 mesh.

A typical data sheet for a single-stage 3/8 inch x 0 rough cleaning run is shown in Table 10. The composites were made in the same manner as described for the Phase I evaluations. In the Phase I evaluations the feed was mathematically reconstituted by combining the analysis of the 1.60 float material and the 1.60 sink material on a weighted basis. In the Phase II evaluations the feed analysis was reconstituted by combining nine different sets of analyses on a weighted basis (Table 9, Column 1) and compared to the actual chemical analysis of a feed sample taken during the run.

The chemical analyses of the actual separation (Table 9, Column 2) was obtained by mathematically combining the material from Zones A, B, and C on a 100 percent basis. The same procedure was also used to obtain the chemical analysis of the 1.60 float material (Table 9, Column 3).

When two-stage cleaning was performed, the weighted composite obtained for the feed material was compiled by combining the chemical data

TABLE 7. SCREEN ANALYSES OF R.O.M. 3/8 INCH x 0 FEED TO CONCENTRATING TABLE

Lot No.	1866		1950		2012	
Seam	Lower Freeport		Ohio 6-A		Upper Freeport	
Run No.	2		2		1	
Type of Run	1.60 Cleaning		Rough Cleaning		Rough Cleaning	
Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 1/4 Inch	6.1	6.1	5.0	5.0	2.8	2.8
1/4 Inch x 6 Mesh	25.5	31.6	24.1	29.1	16.9	19.7
6 Mesh x 12 Mesh	24.1	55.7	24.4	53.5	22.4	42.1
12 Mesh x 0	44.3	100.0	46.5	100.0	57.9	100.0

TABLE 7. SCREEN ANALYSES OF R.O.M. 3/8 INCH x 0 FEED TO CONCENTRATING TABLE (continued)

Lot No.	2013		2031		2026	
Seam	Ohio No. 8		Lower Kittanning		Ohio No. 6	
Run No.	1		1		1	
Type of Run	Rough Cleaning		Rough Cleaning		Rough Cleaning	
Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 1/4 Inch	4.9	4.9	2.5	2.5	4.4	4.4
1/4 Inch x 6 Mesh	25.5	30.4	11.8	14.3	22.2	26.6
6 Mesh x 12 Mesh	25.8	56.2	16.7	31.0	25.8	52.4
12 Mesh x 0	43.8	100.0	69.0	100.0	47.6	100.0

TABLE 8. SCREEN ANALYSES OF 30 MESH x 0 FEED TO CONCENTRATING TABLE

Lot No.	1866*		1950		2012	
Seam	Lower Freeport		Ohio 6-A		Upper Freeport	
Run No.	2		2		1	
Type of Run	R.O.M		Precleaned at 3/8 inch x 0		Precleaned at 3/8 inch x 0	
Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 30 Mesh	2.7	2.7	6.8	6.8	3.5	3.5
30 Mesh x 50 Mesh	26.0	28.7	31.9	38.7	33.6	37.1
50 Mesh x 100 Mesh	26.0	54.7	24.2	62.9	29.5	66.6
100 Mesh x 0	45.3	100.0	37.1	100.0	33.4	100.0

* This sample was a grab sample from pulverizer.

TABLE 8. SCREEN ANALYSES OF 30 MESH x 0 FEED TO CONCENTRATING TABLE (continued)

Lot No.	2012		2031		2026	
Seam	Ohio No. 8		Lower Kittanning		Ohio No. 6	
Run No.	1		1		1	
Type of Run	Precleaned at 3/8 inch x 0		Precleaned at 3/8 inch x 0		Precleaned at 3/8 inch x 0	
Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 30 Mesh	4.2	4.2	0.3	0.3	3.7	3.7
30 Mesh x 50 Mesh	34.6	38.8	18.1	18.4	32.6	36.3
50 Mesh x 100 Mesh	24.1	62.9	31.7	50.1	26.3	62.6
100 Mesh x 0	37.1	100.0	49.9	100.0	37.4	100.0

TABLE 9. ZONES AND FRACTIONS* UTILIZED TO OBTAIN COMPOSITES OF TABLE TESTS

Feed to Table Single Stage*	Actual Separation	1.60 Separation
A	A	A
B	B	B
C 1.60F	C	C 1.60F
C 1.60S		D 1.60F
D 1.60F		
D 1.60 x 2.95		
D 2.95S		
E 2.95F		
E 2.95S		

* Refer to Figure 13

TABLE 10. SAMPLE COPY OF CONCENTRATING TABLE DATA SHEET FOR 3/8 INCH x 0 ROUGH CLEANING RUN

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	47.9		1.17	6.12	1.72	
Zone B	37.3		1.46	6.36	1.98	
Zone C						
Float at 1.60	5.2	79.0	1.21	11.8	4.02	
Sink at 1.60	1.4	21.0	0.36	39.5	12.3	
Composite	6.6	100.0	1.03	17.62	5.76	
Zone D						
Float at 1.60	0.4	4.6	0.60	18.1	4.88	
Float at 2.95	6.7	84.9	1.43	74.2	6.48	
Sink at 2.95	0.8	10.5	0.38	62.2	39.2	9.5
Composite	7.9	100.0	1.28	70.36	9.84	
Zone E						
Float at 2.95	0.1	24.7	1.56	84.2	5.09	4.8
Sink at 2.95	0.2	75.3	0.33	64.9	41.8	4.6
Composite	0.3	100.0	0.63	69.67	32.73	4.65
Composite of Zones A, B, C	91.8		1.28	7.05	2.12	
Composite of 1.60 Float Fractions	90.8		1.29	6.59	1.97	
Composite of 2.95 Sink Fractions	1.0		0.37	62.74	39.72	8.52
Composite of Table Products	100.0		1.28	12.23	2.82	
Analysis of Feed to Table			2.64	12.0	2.90	

of the discarded material (white fraction) from the 3/8 inch x 0 rough-cleaning run, with the data of the fractions produced by recleaning the coal fraction after it had been pulverized to 30 mesh. For example, since in the rough cleaning operation at the 3/8 inch x 0 size (Table 10) a 91.8 - 8.2 percent split was obtained between the black and white fractions, the 91.8 percent black fraction became 100 percent of the material pulverized to 30 mesh for recleaning. The recleaning of the 30 mesh x 0 black fraction was reported on a 100 percent basis as shown in Table 11.

In order to relate the nine separate fractions obtained in this test to the original feed coal, it was necessary to prorate the analyses of the nine samples obtained over the 91.8 percent that this material originally represented and mathematically combine it with analyses of the five different fractions obtained on the white or refuse portion of the 3/8 inch x 0 which represented 8.2 percent of the original material. Table 12, therefore, is purely the mathematical recombination of the chemical analyses of 14 different samples, five from Zones D and E of the 3/8 inch x 0 rough cleaning run from Table 10 and 9 from the 30 mesh x 0 cleaning run from Table 11.

Standard operating settings, recommended by the manufacturer, were utilized in all test runs. A 1/2-inch stroke at 315 strokes per minute was found acceptable for the 30 mesh x 0 runs, and a 3/4-inch stroke at 290 strokes per minute was acceptable for the 3/8 inch x 0 tests. An end elevation of one inch (1/2 inch rise per four feet) was used for both types of tests.

3. Summary of Results

The first coal processed was Lower Freeport seam coal. Two test runs were conducted at an approximate separating gravity of 1.60, one on 3/8 inch x 0 size, and one on 30 mesh x 0 size. Most results obtained were as expected; the one exception was the high ash content of the 30 mesh x 0 clean coal sample. This ash content was higher than that from the clean coal sample obtained from the 3/8 inch x 0 run and considerably higher than the ash obtained in the 1.60 float material from the 30 mesh float-sink analyses.

It was felt that the high ash content of the 30 mesh x 0 clean coal product from the table was caused by the selective ultra-fine pulverization of the shales and their retention in the water that reports to the clean coal side of the table.

To check this theory and to determine whether or not scalping off the shale ahead of the size reduction to 30 mesh would eliminate the problem, a series of four tests was set up for the second test coal, an Ohio No. 6-A seam.

The first test was a conventional 3/8 inch x 0 run attempting a 1.60 separation. The second test was a conventional 30 mesh x 0 run also

TABLE 11. SAMPLE COPY OF CONCENTRATING TABLE DATA SHEET FOR 30 MESH x 0 CLEANING RUN

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	82.2		0.00	5.20	1.39	
Zone B	12.8		1.00	6.03	1.40	
Zone C	0.39	96.7	0.86	9.21	2.02	
Float at 1.60	0.01	3.3	0.50	50.8	19.3	
Sink at 1.60	0.4	100.0	0.85	10.58	2.59	
Composite						
Zone D						
Float at 1.60	2.0	48.6	0.61	17.7	4.09	
Float at 2.95	1.9	45.4	0.60	54.0	11.4	
Sink at 2.95	0.2	6.0	0.18	63.2	40.7	6.4
Composite	4.1	100.0	0.58	36.91	9.61	
Zone E						
Float at 2.95	0.02	4.3	0.70	64.5	19.4	13.8
Sink at 2.95	0.48	95.7	0.14	63.7	40.2	5.6
Composite	0.5	100.0	0.16	63.73	39.31	5.95
Composite of Zones A, B, C	95.4		0.14	5.33	1.40	
Composite of 1.60 Float Fractions	97.4		0.15	5.59	1.45	
Composite of 2.95 Sink Fractions	0.68		0.15	63.56	40.34	5.83
Composite of Table Products	100.0		0.16	6.92	1.92	
Analysis of Feed to Table			2.67	6.52	2.04	

TABLE 12. SAMPLE COPY OF CONCENTRATING TABLE DATA SHEET SHOWING THE EFFECTS OF TWO-STAGE CLEANING

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Composite of 3/8 Inch x 0 Run (6/4/68) and 30 Mesh x 0 Run (6/13/68)

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	75.4		0.00	5.20	1.39	
Zone B	11.7		1.00	6.03	1.40	
Zone C	0.39	96.7	0.86	9.21	2.02	
Float at 1.60	0.01	3.3	0.50	50.8	19.3	
Sink at 1.60	0.4	100.0	0.85	10.58	2.59	
Composite						
Zone D						
Float at 1.60	2.3	19.7	0.61	17.77	4.23	
Float at 2.95	8.4	71.8	1.25	69.91	7.52	
Sink at 2.95	1.0	8.5	0.34	62.40	39.50	8.9
Composite	11.7	100.0	1.05	59.00	9.59	
Zone E						
Float at 2.95	0.12	15.0	1.42	80.91	7.48	6.3
Sink at 2.95	0.68	85.0	0.20	64.05	40.67	5.3
Composite	0.8	100.0	0.38	66.58	35.69	5.45
Composite of Zones A, B, C	87.5		0.14	5.33	1.40	
Composite of 1.60 Float Fractions	89.8		0.15	5.65	1.47	
Composite of 2.95 Sink Fractions	1.7		0.28	63.07	39.97	7.42
Composite of Table Products	100.0		0.25	12.10	2.63	
Analysis of Feed to Table			2.64	12.0	2.90	

attempting a 1.60 separation. The third was a 3/8 inch x 0 scalping run to effect a black and white separation. The feed for the fourth run was obtained by crushing the black 3/8 inch x 0 fraction to 30 mesh and recleaning it at 1.60 specific gravity. With the data obtained in the third and fourth runs it was possible to relate the final 30 mesh x 0 clean coal product to the original 3/8 inch x 0 raw coal.

As expected, the ash in the clean coal from the single-stage cleaning was higher than the ash in the clean coal from the two-stage cleaning. On the basis of the four runs with the Ohio 6-A coal it was decided to clean the remaining four coals in two stages, with black and white separation at the 3/8 inch x 0 size and secondary cleaning of the black fraction after reduction to 30 mesh in size.

The chemical data from the numerous table tests with the six different coals are presented in Tables 13 to 17. Table 13 shows the effect of single-stage cleaning at 3/8 inch and 30 mesh topsize on the first two coals studied. The effect of two-stage cleaning on reducing the ash content of the clean coal at the 30 mesh topsize is shown in Table 14. Table 15 presents additional data for the second coal tested, Ohio 6-A, on the four runs, as well as the mathematical composite obtained from the two-stage cleaning.

Table 16 compares the theoretical float-sink separation at 1.60 specific gravity to the actual separation obtained with the table, at the 30 mesh x 0 size, for the last five coals tested. The effect of two-stage cleaning of the same coals is shown in Table 17.

Figure 21 shows the effect of single-stage cleaning for the first two coals tested at the 3/8 inch x 0 size and the 30 mesh x 0 size. Both coals show increased recovery and a greater sulfur reduction when they are cleaned at the finer size (30 mesh x 0). The Lower Freeport exhibits both the greater increase in recovery (longer line) and the greater reduction in total sulfur (less perpendicular slope).

Figure 22 compares single-stage to two-stage cleaning using the Ohio 6-A seam coal at the 3/8 inch and 30 mesh topsizes. It should be noted that the curve for single-stage cleaning is identical to the one for the 6-A coal shown in the previous figure (Figure 21).

The results of two-stage cleaning of this coal are quite interesting. The rough cleaning, or black and white separation at the 3/8 inch x 0 size, gave the expected results when compared to the 3/8 inch x 0 conventional. The recovery increased and the percent of total sulfur reduction decreased. The final recovery from the two-stage cleaning looks rather poor, but this is not the case. The total sulfur reduction was increased by approximately 13 percent over the comparative 30 mesh x 0 run on the R.O.M. coal. The high recovery shown for the 30 mesh x 0 single-stage cleaning is a false recovery since 2-1/2 percent of it is extra ash. This is shown in Table 14.

TABLE 13. CONCENTRATING TABLE TESTS

Effects of Single-stage Cleaning on Two Coals

Coal Identification Seam County State	BCR Lot No.	Feed Size	Feed Rate tph	Total Sulfur, Feed to Table*	Recovery, Clean Coal	Total Sulfur, Clean Coal	Total Sulfur Reduction
Lower Freeport	1866	3/8 Inch x 0	2.05	2.17	78.1	1.17	46.1
Armstrong, Pa.	1866	30 Mesh x 0	1.04	2.16	84.6	1.00	53.7
No. 6-A	1950	3/8 Inch x 0	2.42	2.58	88.2	1.69	34.5
Harrison, Ohio	1950	30 Mesh x 0	1.01	2.44	92.0	1.55	36.5

* Composite of Table Products

TABLE 14. CONCENTRATING TABLE TESTS

Chemical Analyses Comparison Between 1.60 Theoretical Cleaning and Concentrating Table Cleaning for Two Coals at 30 Mesh x 0 Size

Coal Identification Seam County, State	BCR Lot No.	Method	Weight Percent, Dry Basis		
			Recovery, Clean Coal	Ash, Clean Coal	Total Sulfur, Clean Coal
Lower Freeport	1771	Float-Sink Analysis	84.5	6.46	0.94
Armstrong, Pa.	1866	Single-Stage Cleaning	84.6	11.96	1.00
No. 6-A	1735	Float-Sink Analysis	86.6	4.42	0.90
Harrison, Ohio	1950	Single-Stage Cleaning	92.0	7.82	1.55
	1950	Two-Stage Cleaning	87.5	5.33	1.40

TABLE 15. CONCENTRATING TABLE TESTS

Comparison Between Single-stage and Two-stage Cleaning on Ohio No. 6-A Seam

at Nominal Topsize of Coal

BCR Lot No. 1950

	Weight Percent, Dry Basis			
Feed Size	Total Sulfur, Feed to Table*	Recovery, Clean Coal	Total Sulfur, Clean Coal	Total Sulfur Reduction
Single-stage Cleaning				
3/8 Inch x 0	2.58	88.2	1.69	34.5
30 Mesh x 0	2.44	92.0	1.55	36.5
Two-stage Cleaning				
3/8 Inch x 0	2.82	91.8	2.12	24.8
30 Mesh x 0	1.92	95.4	1.40	27.1
Composite	2.82	87.5	1.40	50.4

* Composite of Table Products

TABLE 16. CONCENTRATING TABLE TESTS

Comparison Between 1.60 Theoretical Cleaning and Two-stage Concentrating Table Cleaning at 30 Mesh x 0 Size

Coal Identification Seam County State	BCR Lot No.	Method	Weight Percent, Dry Basis			
			Total Sulfur, Feed	Recovery, Clean Coal	Total Sulfur, Clean Coal	Total Sulfur Reduction
No. 6-A	1735	Float-sink Analysis	2.50	86.6	0.90	64.0
Harrison, Ohio	1950	Concentrating Table	2.82	87.5	1.40	50.4
Upper Freeport	1750	Float-sink Analysis	3.74	70.2	1.07	71.4
Westmoreland, Pa.	2012	Concentrating Table	3.34	81.4	1.07	68.0
No. 8	1768	Float-sink Analysis	4.71	74.0	2.79	40.8
Jefferson, Ohio	2013	Concentrating Table	3.83	87.4	2.72	29.0
No. 6	1745	Float-sink Analysis	2.44	85.7	0.76	68.9
Columbiana, Ohio	2026	Concentrating Table	4.38	90.7	1.65	62.3
Lower Kittanning	1755	Float-sink Analysis	4.66	70.6	1.32	71.7
Indiana, Pa.	2031	Concentrating Table	4.77	78.8	1.54	67.7

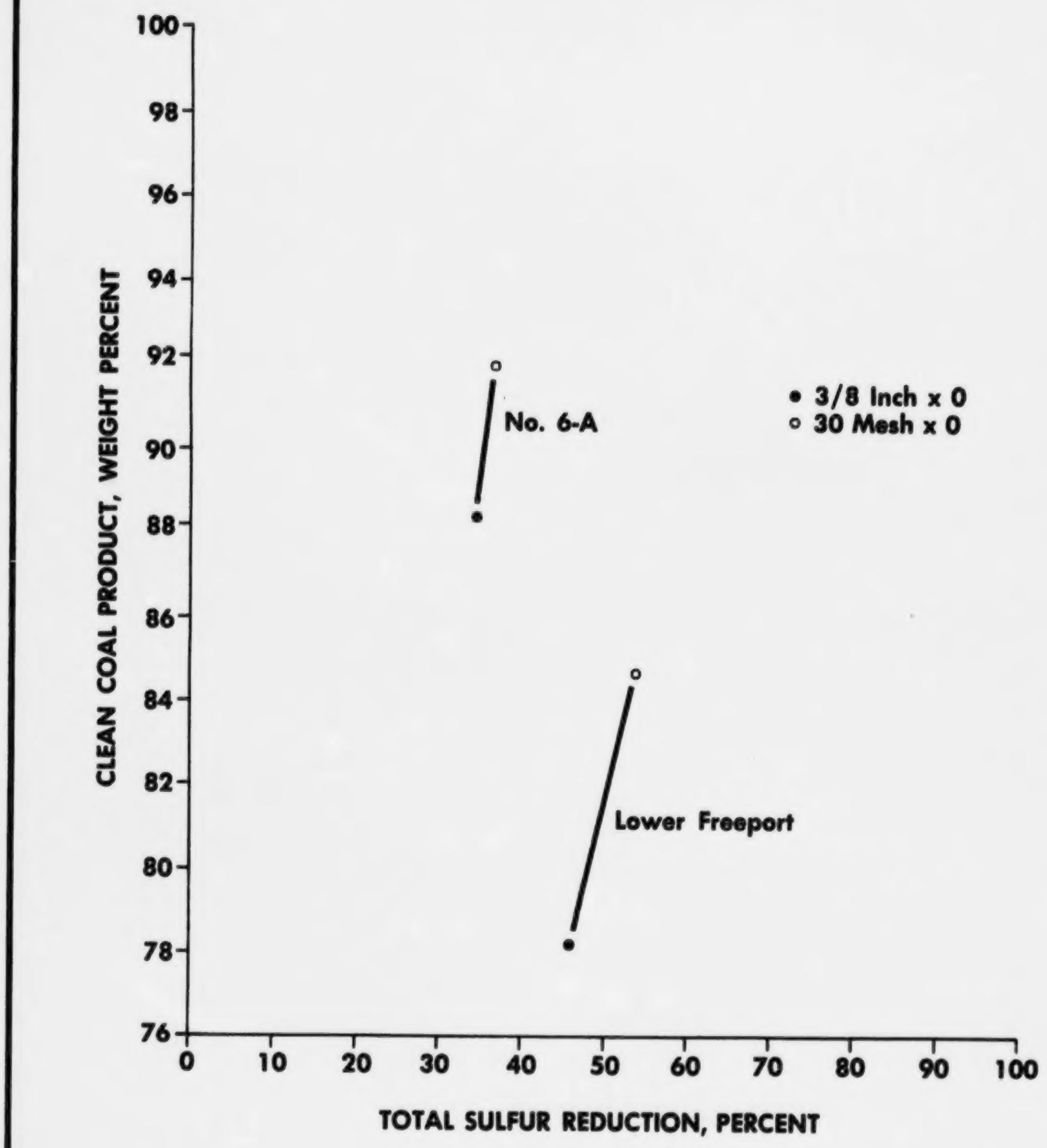
TABLE 17. CONCENTRATING TABLE TESTS

Effects of Two-stage Cleaning

Coal Identification Seam County State	BCR Lot No.	Feed Size	Feed Rate tph	Weight Percent, Dry Basis			
				Total Sulfur, Feed to Table	Recovery, Clean Coal	Total Sulfur, Clean Coal	Total Sulfur Reduction
No. 6-A	1950	3/8 Inch x 0	2.39	2.82	91.8	2.12	24.8
Harrison, Ohio	1950	30 Mesh x 0	1.13	--	87.5**	1.40	50.4
Upper Freeport	2012	3/8 Inch x 0	2.66	3.34	84.9	1.76	47.3
Westmoreland, Pa.	2012	30 Mesh x 0	1.09	--	81.4**	1.07	68.0
No. 8	2013	3/8 Inch x 0	2.85	3.83	92.4	3.29	14.1
Jefferson, Ohio	2013	30 Mesh x 0	.99	--	87.4**	2.72	29.0
No. 6	2026	3/8 Inch x 0	2.62	4.38	94.4	2.57	41.3
Columbiana, Ohio	2026	30 Mesh x 0	1.00	--	90.7**	1.65	62.3
Lower Kittanning	2031	3/8 Inch x 0	2.55	4.77	83.5	1.98	58.5
Indiana, Pa.	2031	30 Mesh x 0	.82	--	78.8**	1.54	67.7

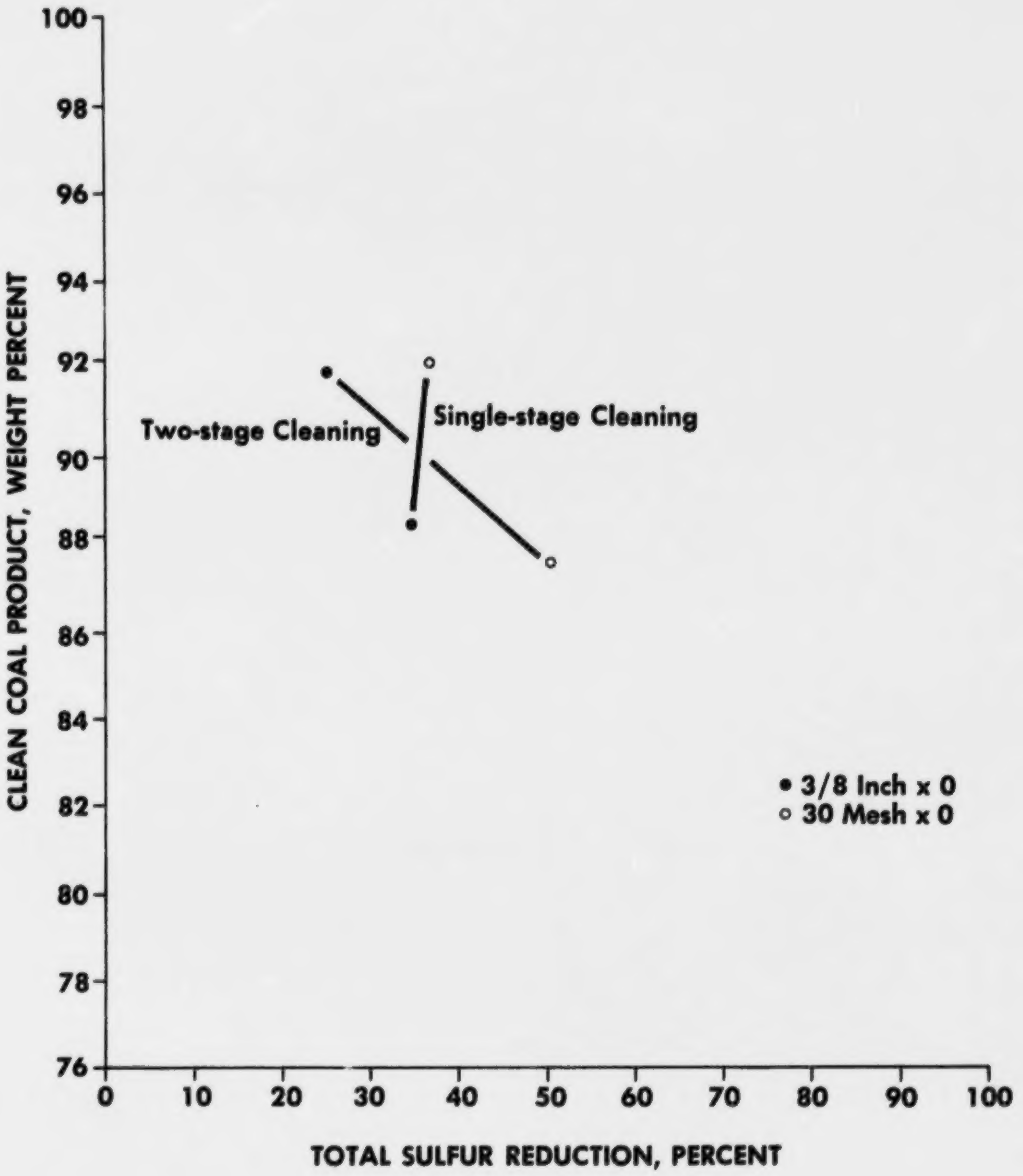
* Composite of Table Products

** Based on 100 Percent 3/8 Inch x 0 Raw Coal Feed



Bituminous Coal Research, Inc. 6070G23

Figure 21. Concentrating Table Tests—Effects of Single-stage Cleaning on Two Study Coals



Bituminous Coal Research, Inc. 6070G24

Figure 22. Comparison between Single-stage and Two-stage Cleaning on No. 6-A Seam at Nominal Topsize of Coal, Concentrating Table Tests

In Figure 23, a graphic comparison is made of the five coals tested by two-stage cleaning. The general clustering of the three Ohio coals in one area of the graph and the clustering of the two Pennsylvania coals in another area is significant. The lateral displacement is in part caused by the higher organic sulfur content of the Ohio coals, and the vertical displacement would indicate that the Pennsylvania coals contained more rock in the R.O.M. coal. All five coals exhibited about the same loss of recovery between the 3/8 inch x 0 rough cleaning runs and the 30 mesh x 0 runs, as indicated by the length of the lines on the graph. The Lower Kittanning coal showed the least beneficiation from the two-stage cleaning and the No. 6-A seam from Ohio the greatest, as shown by the slope of the lines.

The information contained in Figure 24, comparing the Phase I results with those from two-stage cleaning, is also interesting. In all cases, the recovery obtained from two-stage cleaning was better than that obtained from the float-sink tests in Phase I. Table 16 shows that some of the difference can be explained by the differences in chemical analyses between the lots of coals utilized for the tests in the two phases of work. The chemical composition of the coal changed slightly during the long lapse of time between the time Commercial Testing obtained their samples for the Phase I testing and that when BCR obtained the samples for Phase II testing. The differences in recovery are also accompanied by the expected differences in total sulfur reduction.

With the exception of the tests with the No. 6 seam, the predicted sulfur in the clean coal obtained by the Phase I float-sink tests compares very favorably to the total sulfur obtained in the clean coal produced from the two-stage cleaning of the coals on the concentrating table.

In addition to the tests described, four of the coals were rough-cleaned at the 3/8 inch x 0 size to prepare a 30 mesh x 0 black fraction for testing the concentrating spiral and the compound water cyclone. The results of these four runs are contained in Appendixes C and D, Attachments C-11, 16, 21, 26, and D-2, 5, 8, 11. With exception again of the Ohio No. 6 seam coal (Lot No. 2026), the duplication between the 3/8 inch x 0 rough cleaning runs from the same coal lot was excellent.

A complete list of actual concentrating tests, cross-referenced by BCR lot number and attachment number, is shown in Table 18. Run date and feed rates are also shown.

C. Compound Water Cyclone

1. Description of Theory of Operation

Figure 25 shows the internal construction of a typical compound water cyclone. The following information from a manufacturer's brochure gives an excellent description of the theory of operation:

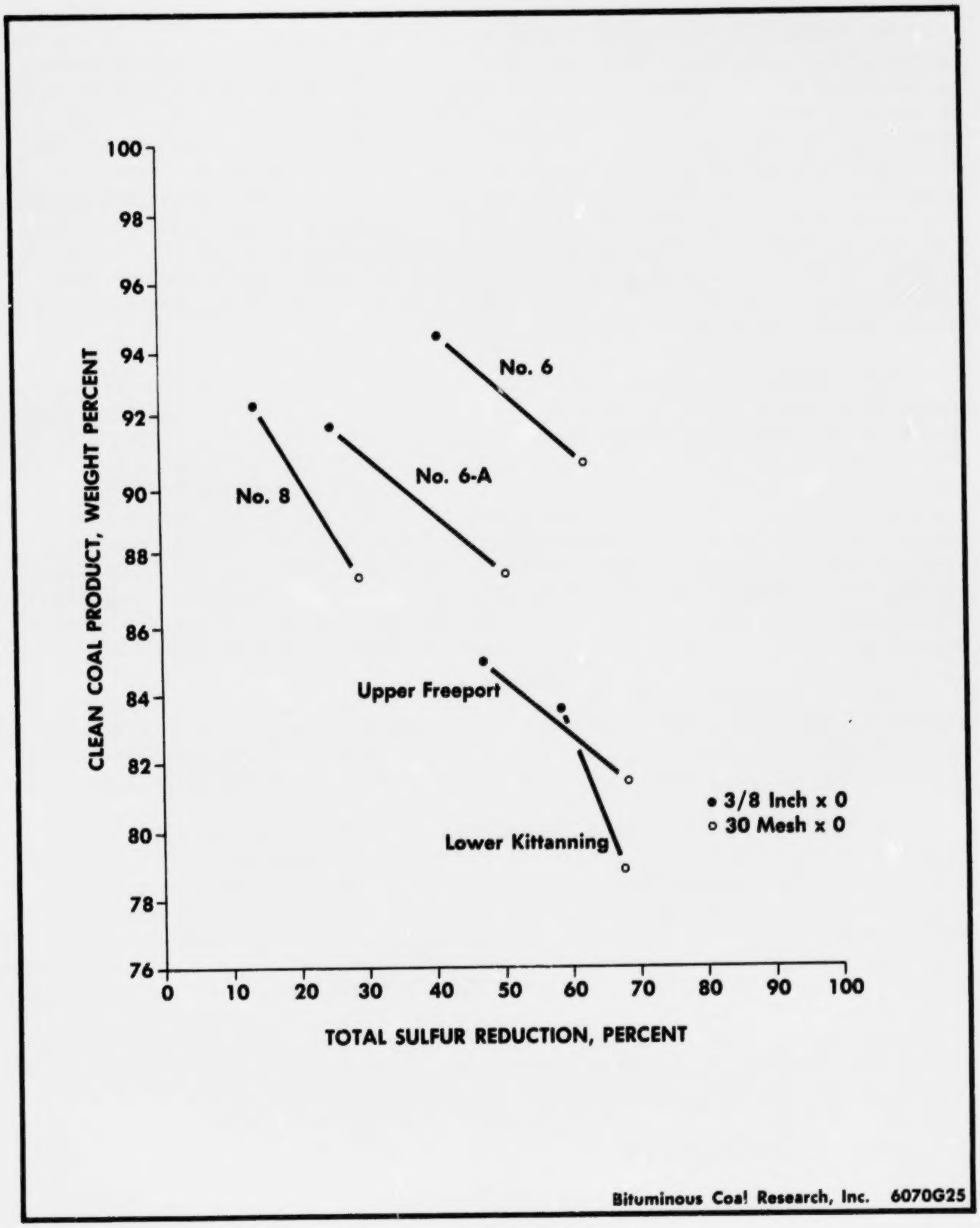
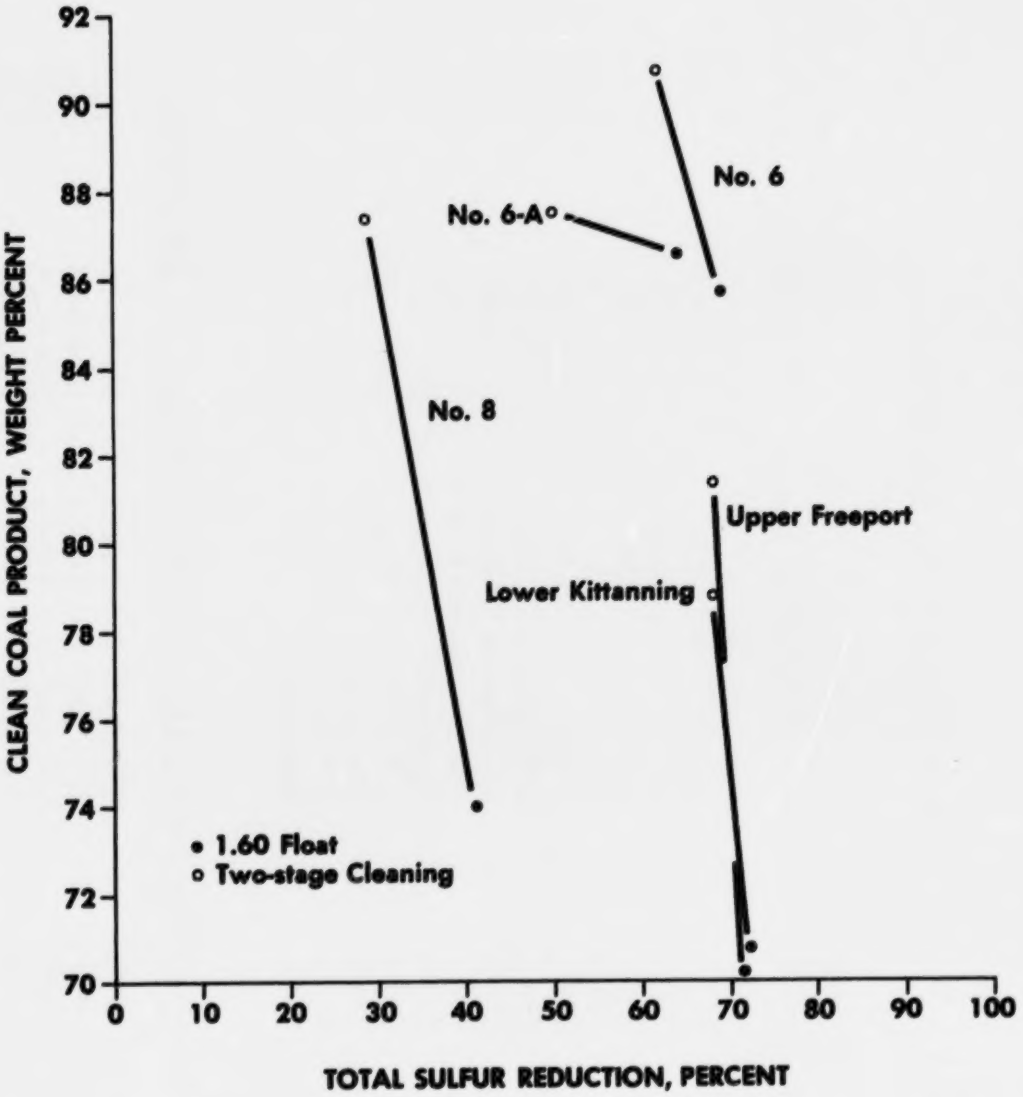


Figure 23. Concentrating Table Tests—Effects of Two-stage Cleaning



Bituminous Coal Research, Inc. 6070G26

Figure 24. Concentrating Table Tests—Comparison between 1.60 Theoretical Cleaning and Two-stage Concentrating Table Cleaning at 30 Mesh x 0 Size

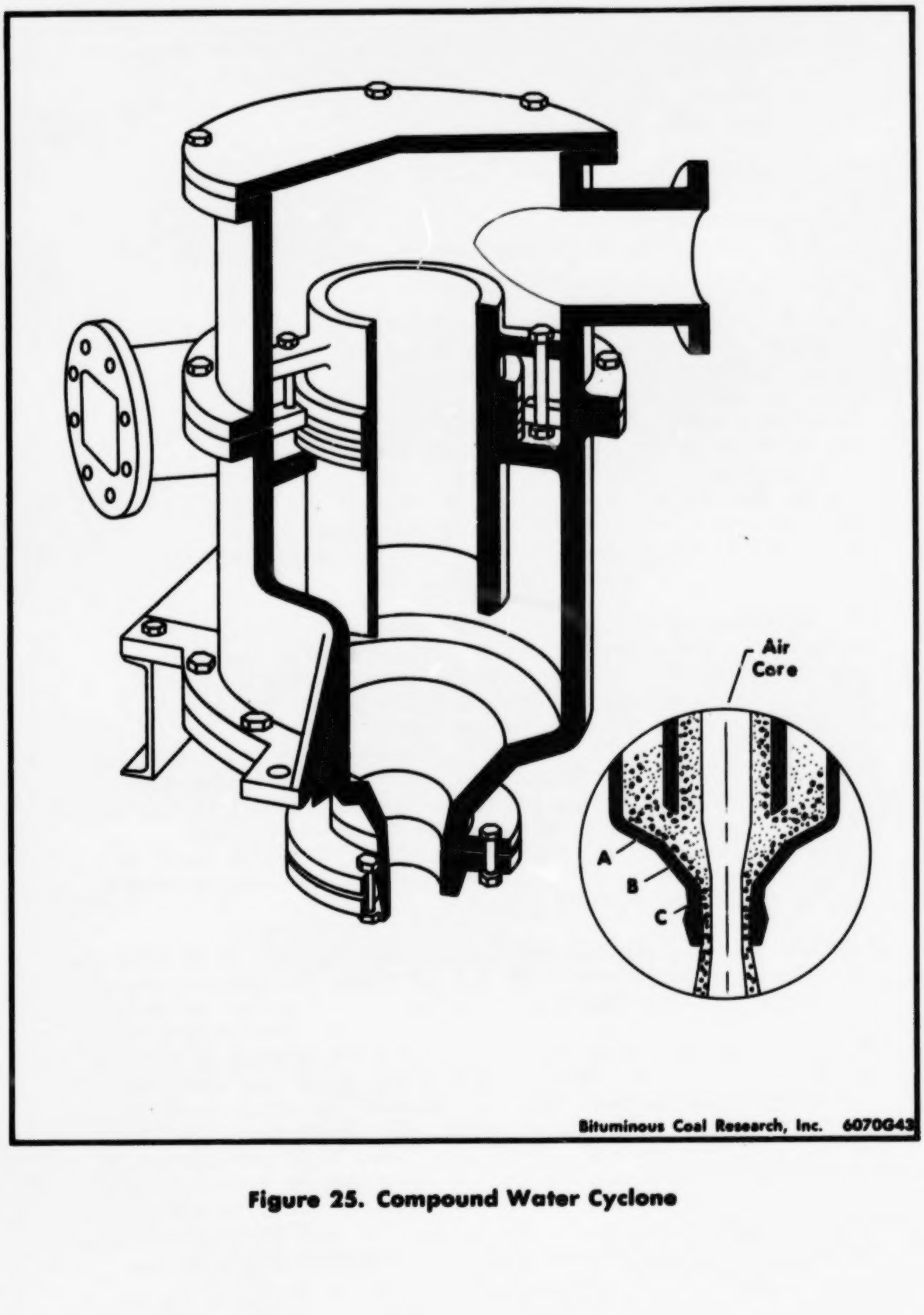
TABLE 18. LIST OF CONCENTRATING TABLE RUNS

Concentrating Table Evaluations

Lot No.	Attachment B No.	Description	Date Run	Feed Rate (lb/hr)	tph
1866	B-2	Raw 30 M x 0	5-13-68	2076	1.04
1866	B-1	Raw 3/8 Inch x 0	5-14-68	4105	2.05
1950	B-3	Raw 3/8 Inch x 0	5-28-68	4842	2.42
1950	B-5	3/8 Inch x 0 Rough	6- 4-68	4770	2.39
1950	B-4	Raw 30 M x 0	6- 5-68	2016	1.01
1950	B-6	Precleaned 30 M x 0	6-13-68	2256	1.13
2012	B-8	3/8 Inch x 0 Rough	6-25-68	5316	2.66
2013	B-11	3/8 Inch x 0 Rough	6-28-68	5694	2.85
2012	B-9	Precleaned 30 M x 0	7- 2-68	2172	1.09
2013	B-12	Precleaned 30 M x 0	7- 5-68	1974	0.99
2031	B-17	3/8 Inch x 0 Rough	7-18-68	5106	2.55
2031	B-18	Precleaned 30 M x 0	7-24-68	1632	0.82
2026	B-14	3/8 Inch x 0 Rough	7-29-68	5238	2.62
2026	B-15	Precleaned 30 M x 0	7-31-68	2006	1.00

Concentrating Spiral and Compound Water Cyclone Evaluations

Lot No.	Attachment B No.	Description	Date Run	Feed Rate (lb/hr)	tph
2031	C-11, D-2	3/8 Inch x 0 Rough	10-11-68	5355	2.68
2026	C-16, D-5	3/8 Inch x 0 Rough	10-18-68	4844	2.42
2012	C-21, D-8	3/8 Inch x 0 Rough	11- 6-68	5110	2.56
2013	C-26, D-11	3/8 Inch x 0 Rough	11-27-68	4920	2.46


Air Core
A
B
C

Bituminous Coal Research, Inc. 6070G43

Figure 25. Compound Water Cyclone

The cross section view of the compound water cyclone demonstrates the separation of raw coal into two products--(1) clean, low-ash coal and (2) refuse that is high in sulfur, ash, and pyrite.

A coal/water pulp enters the central feed chamber through the cycloidal inlet. The cycloidal configuration of the inlet imparts an initial circular motion to the pulp and partial centrifugal separation begins within the nozzle itself.

Particles of different sizes and specific gravity form a hindered settling bed in the first conical section (A). Light, coarse particles are prevented from penetrating the lower strata of this bed by the coarse, heavy fractions (middlings and refuse) and by the fine particles filling the interstices of the bed. Consequently, the water--passing from the periphery of the cyclone toward its main outlet (the vortex finder)--erodes the top of the stratified bed and substantially removes the light, coarse particles via the central current around the air core (vortex).

The remainder of the bed--without measurabley losing its stratified character--is forced into the second conical section (B) by the mass of new feed entering the cyclone. Here, the central current is much stronger and further erodes the top of the bed, exposing the middlings. The light middlings are swept up and discharged via the vortex finder. The heavy middlings that spiral upward in the central current of departing water may by-pass the orifice of the lower vortex finder owing to their higher specific gravity. Consequently, the coarse, heavy middlings fraction tends to recirculate to the stratified bed and finally enters the third conical section (C).

In this last and smaller conical section, the bed is finally destroyed as coarse particles fan out along the cyclone wall in a single layer, exposing the small particles that so far have been shielded from the central current. The central current of departing water in this smallest section is relatively weak, having spent itself in the preceding sections. The upward current that remains separates the small particles from the remainder of the material, with preference for those of low specific gravity. Thus, the fine, light particles are finally discharged through the vortex finder by a process of elutriation. The refuse, fine as well as coarse, is discharged through the apex. The separation thus takes place in three steps, as summarized in the diagrammatic model shown.

The cut point can be set at a higher or lower specific gravity by changing the settings of the cyclone in accordance with the nature of the raw material and the requirements of the user.

2. Test Setup and Procedure

Considerable time was devoted to developing the test procedure for the compound water cyclone. The first step in preparing the coal for the test work with the first coal was, of course, rather straightforward and consisted of pulverizing the feed coal to minus 30 mesh in size. The first set of tests was conducted with the Ohio 6-A seam in the R.O.M. condition. The feed material for the remaining four tests was prepared by pulverizing the black fraction of the 3/8 inch x 0 rough-cleaning run from the concentrating table to minus 30 mesh in size. This approach paralleled the two-stage cleaning with the concentrating table.

Batch tests were conducted in all cases, but an elaborate mixing system had to be devised to insure that the feed to the cyclone was constant at all times. The principle that made the mixing circuit necessary is important, and can best be explained by using a simple, closed circuit, slurry handling system consisting of a pump, a slurry sump, and a "U"-shaped pipe between the pump discharge and the sump. If a mixture of coal and pyrite is prepared into a slurry of known specific gravity, placed in the sump and circulated, the specific gravity of the slurry discharging back to the sump will increase slowly. This is due to the fact that the circulating portion of the slurry will build up with the heavier particles (pyrite) and the larger pieces of coal, since they settle very fast in the sump and return directly to the suction side of the pump.

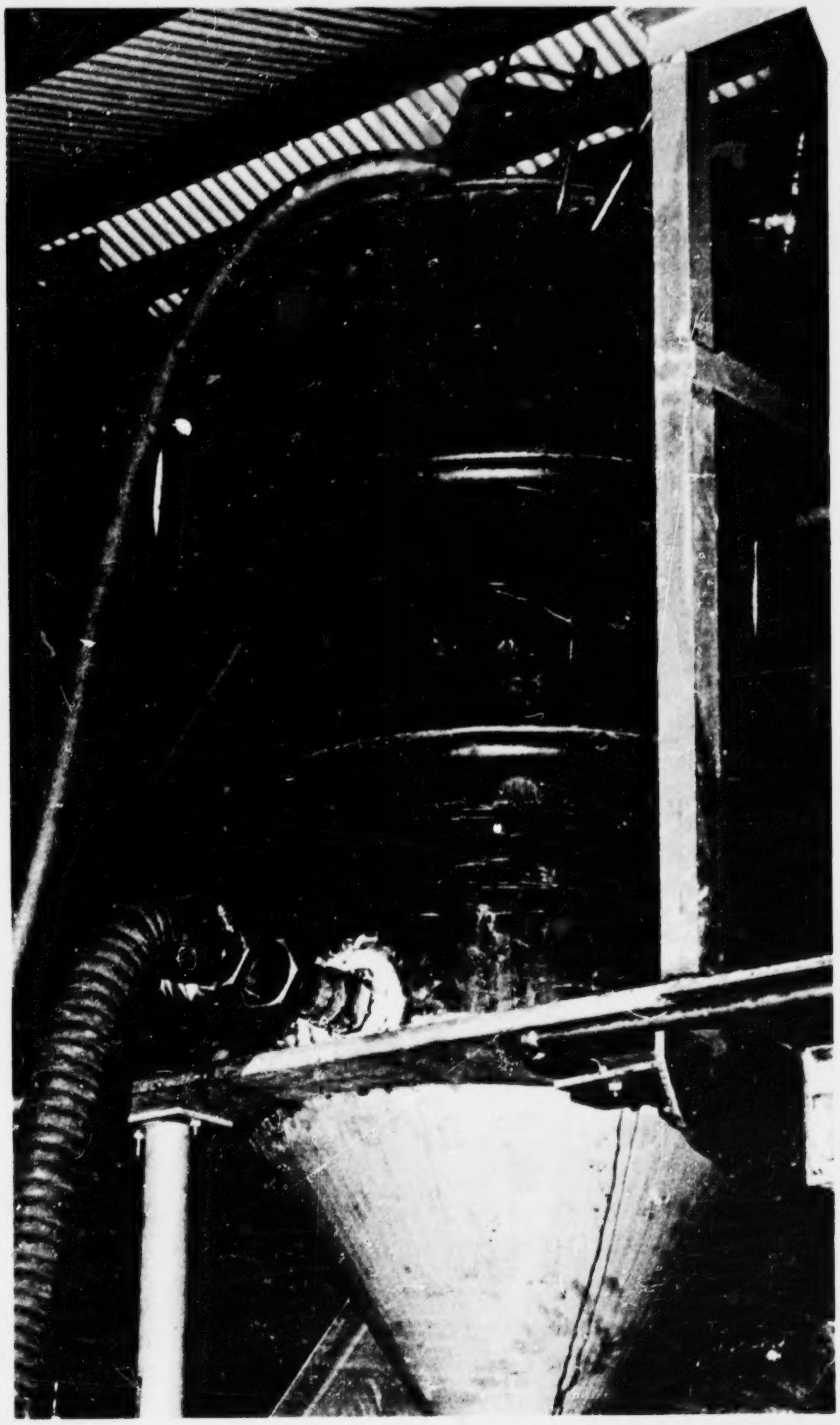
Figure 26 shows a portion of the mixing circuit set up for tests with the compound water cyclone and subsequently used in the spiral concentrator testing.

The primary modification made to the mixing circuit was the addition of a second pump and recirculating circuit which ran continuously while the original pump supplied the feed material to the triclone. Figure 27 shows the original mixing circuit while Figure 28 shows the final version of this circuit.

The compound water cyclone is shown in Figure 29 with a portion of the sampling chutes in the foreground.

The complete compound water cyclone circuit is shown in Figure 30, and the sampling and analytical flow diagram is shown in Figure 31.

The sampler was designed so that the overflow and underflow were sampled for the same period of time and at the same time. One increment was obtained, but the total sample was a rather high percentage of total quantity of slurry utilized in the test.



(6070P29)

Figure 26. Slurry Feed Mixing Cone for Compound Water Cyclone and Spiral Concentrator

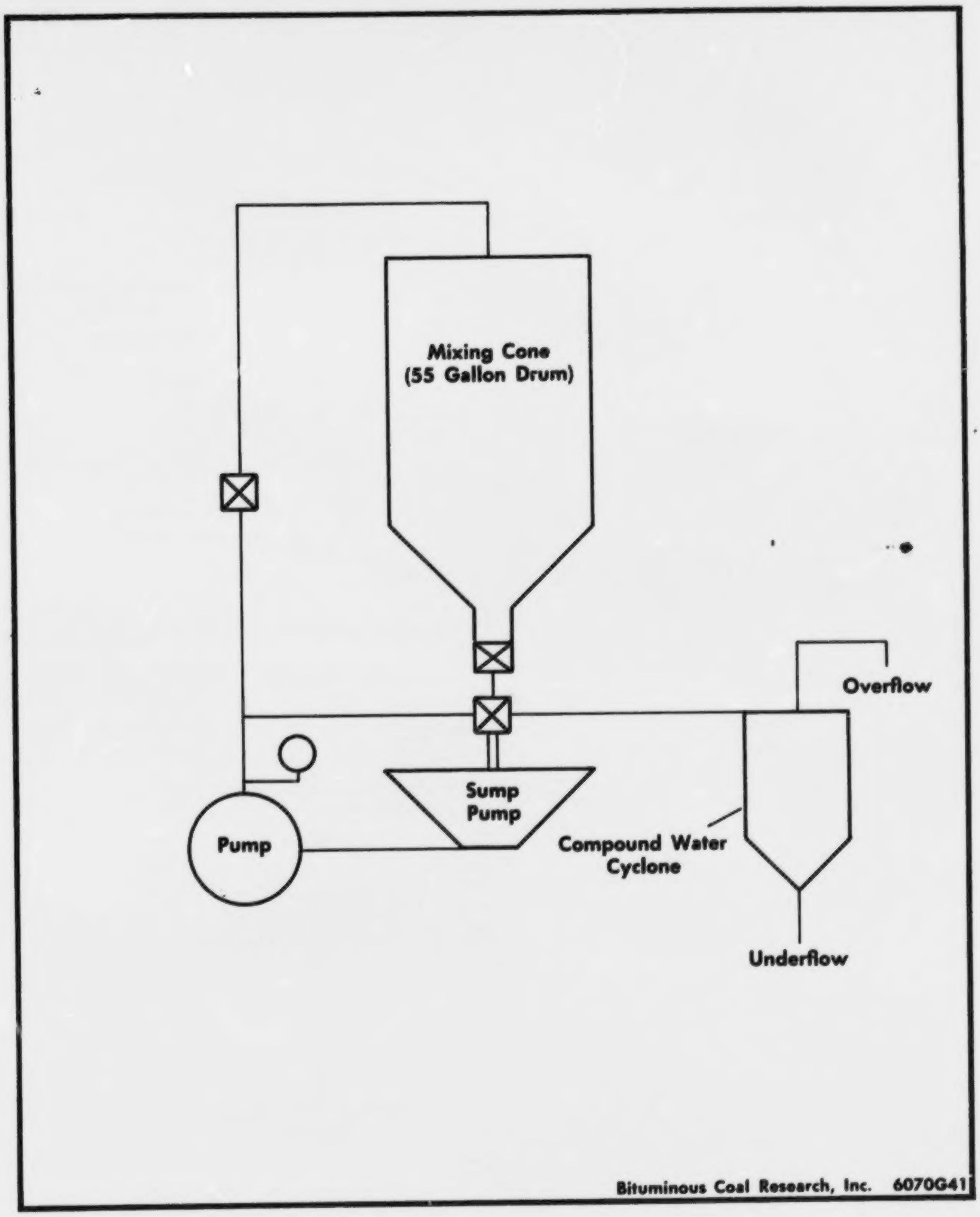

Mixing Cone
(55 Gallon Drum)
Overflow
Sump
Pump
Pump
Compound Water
Cyclone
Underflow
Bituminous Coal Research, Inc. 6070G41

Figure 27. Original Mixing Circuit for Compound Water Cyclone Tests

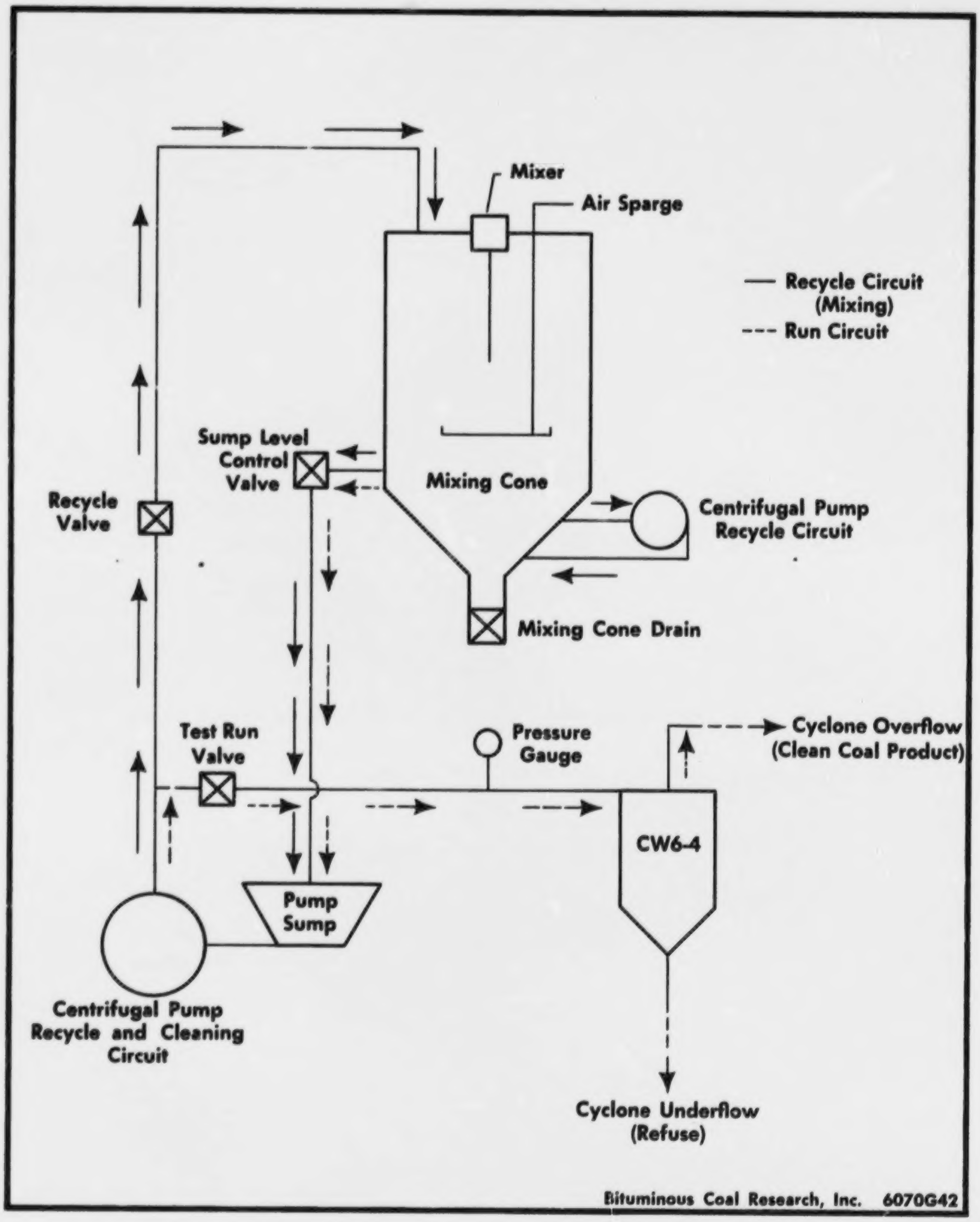
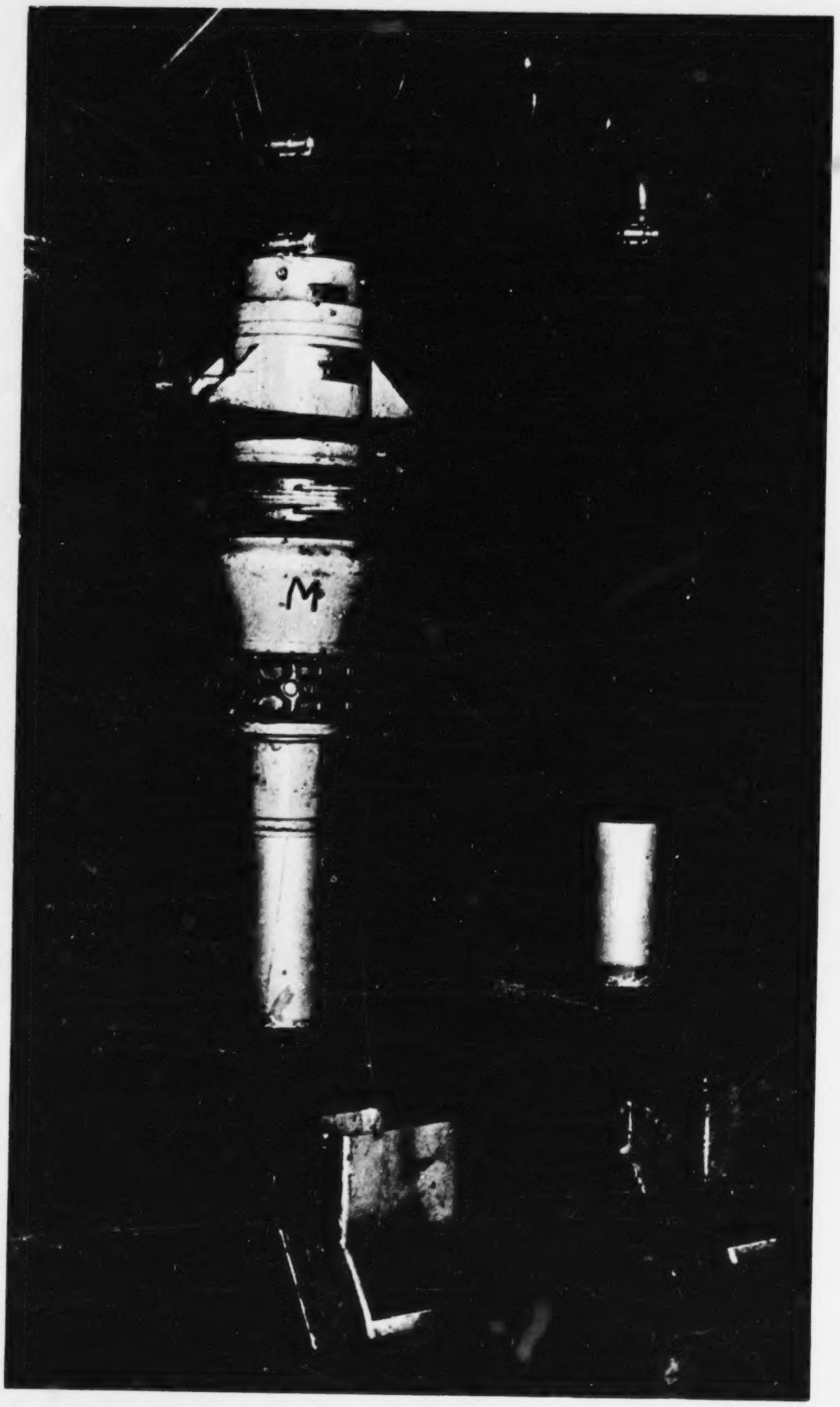
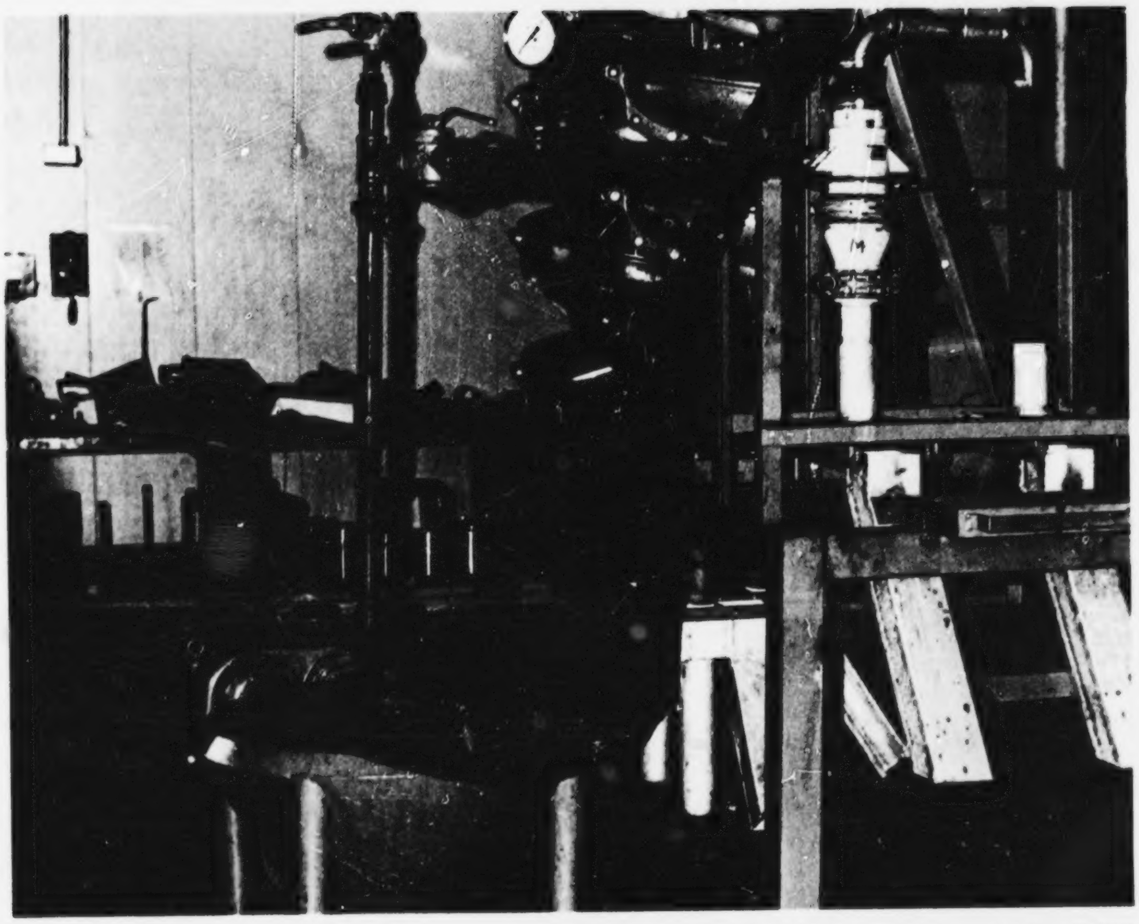

Mixer
Air Sparge
— Recycle Circuit (Mixing)
--- Run Circuit
Sump Level Control Valve
Mixing Cone
Recycle Valve
Centrifugal Pump Recycle Circuit
Mixing Cone Drain
Test Run Valve
Pressure Gauge
Cyclone Overflow (Clean Coal Product)
CW6-4
Pump Sump
Centrifugal Pump Recycle and Cleaning Circuit
Cyclone Underflow (Refuse)
Bituminous Coal Research, Inc. 6070G42

Figure 28. Final Mixing Circuit for Compound Water Cyclone Tests



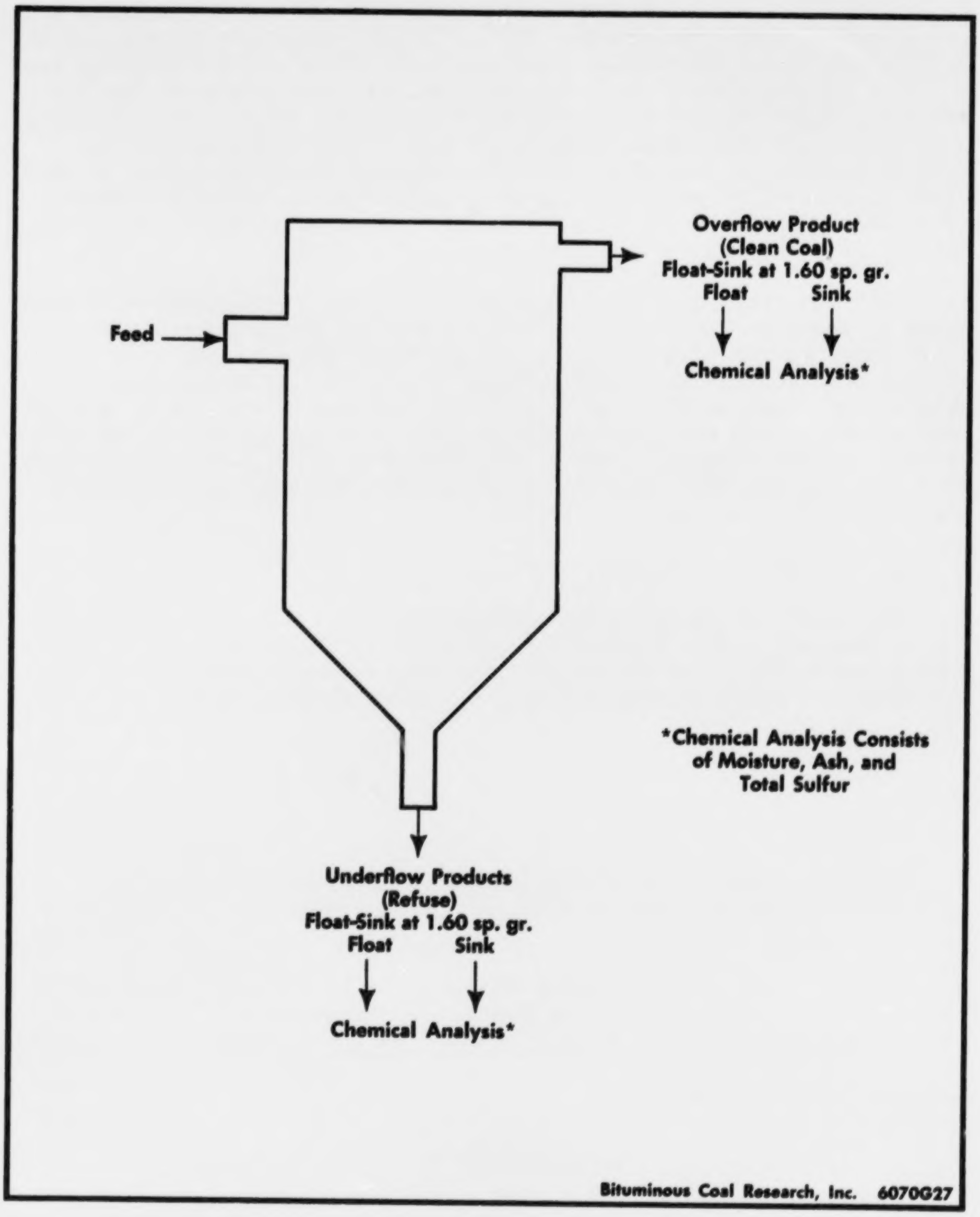
(6070P23)

Figure 29. Compound Water Cyclone with Sampling Chutes in the Foreground



(6070P20)

Figure 30. View of the Complete Compound Water Cyclone Circuit with Concentrating Spirals in the Background


Feed
Overflow Product
(Clean Coal)
Float-Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*
Underflow Products
(Refuse)
Float-Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*

*Chemical Analysis Consists of Moisture, Ash, and Total Sulfur

Bituminous Coal Research, Inc. 6070G27

Figure 31. Sampling Flow Sheet for Compound Water Cyclone Tests

Table 19 is a typical data sheet used for both the single-stage and two-stage compound water cyclone tests. For single-stage cleaning of the R.O.M. coal, the total sulfur reduction could be calculated directly from the data on this sheet. Although the sample of data presented was for two-stage cleaning, the total sulfur reduction for single-stage cleaning would have been calculated as follows: The entire overflow from the cyclone constitutes the clean coal fraction and the total sulfur in the clean coal was 1.59 percent. The total sulfur in the feed is obtained from the composite of the cyclone products, or 1.81 percent. Thus, the total sulfur reduction would have been 12.2 percent.

With two-stage cleaning, a second data sheet was necessary and this sheet is shown in Table 20. The basic mechanics for calculating the final total sulfur reduction obtained for two-stage cleaning is identical to that utilized in the concentrating table tests. This reduction is obtained by starting with the total sulfur content of the R.O.M. coal as fed to the concentrating table in the rough cleaning operation, or 2.90 percent in this example. Sulfur content of the final clean coal product from the compound water cyclone in the example was 1.59 percent, a reduction of 45.2 percent.

3. Summary of Results

The first set of tests was conducted on the R.O.M. Ohio 6-A coal at the 30 mesh x 0 size. The results are shown in Table 21. In the following table, Table 22, the results from two compound water cyclone runs are compared to the 30 mesh x 0, R.O.M., concentrating table run.

TABLE 22. COMPARISON OF CONCENTRATING TABLE RUN AND COMPOUND WATER CYCLONE RUN WITH 30 MESH x 0, R.O.M., OHIO NO. 6-A SEAM

Cleaning Unit	Total Sulfur in Feed, Weight Percent	Recovery, Weight Percent	Total Sulfur Reduction, Weight Percent
Compound Water Cyclone (Test No. 3, Run No. 6)	2.47	91.4	21.1
Compound Water Cyclone (Test No. 2, Run No. 2)	2.39	90.9	27.6
Concentrating Table Run	2.44	92.0	36.5

TABLE 19. SAMPLE COPY OF DATA SHEET FOR COMPOUND WATER CYCLONE TEST

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (10-18-68) Crushed to 30 Mesh x 0, Test No. 6,

Run No. 1

BCR Sample No. 2026

Operating Conditions:

Cone Type S
Vortex Finder Clearance 1 in.
Inlet Pressure 5 psi
Dry Feed, tph 0.7

Specific Gravity, Pulp 1.02
Flowrate of Pulp, usgpm 34.2
Specific Gravity, Solids 1.35
Weight Percent, Solids 8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	90.4	96.8	3.74	1.06
Sink at 1.60	3.0	3.2	41.6	17.6
Composite	93.4	100.0	4.95	1.59
Underflow				
Float at 1.60	5.7	86.3	5.36	1.32
Sink at 1.60	0.9	13.7	52.6	27.2
Composite	6.6	100.0	11.83	4.87
Composite of Cyclone Products	100.0		5.40	1.81
Analysis of Feed to Cyclone			5.52	1.77

Run Date: 12-10-68

TABLE 20. SAMPLE COPY OF DATA SHEET SHOWING EFFECTS OF TWO-STAGE CLEANING WITH THE CONCENTRATING TABLE AND COMPOUND WATER CYCLONE

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2026

Concentrating Table Test Run Date 10-18-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	7.93	2.90		
Composite of Zones A, B, C	94.1	5.39	1.92	32.0	33.8

Compound Water Cyclone Test No. 6, Run No. 1 Run Date 12-10-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC	100.0	5.40	1.81		
Clean Coal Product	93.4	4.95	1.59	8.3	12.2
Two-Stage Clean Coal Product	87.9	4.95	1.59	37.6	45.2

* Based on Composite of CWC Products

TABLE 21. COMPOUND WATER CYCLONE TESTS - SINGLE-STAGE CLEANING

No. 6-A Seam, Harrison County, Ohio
Raw Run-of-Mine Coal Crushed to 30 Mesh x 0,
BCR Sample No. 1950

Test and Run	Total Sulfur, in Feed* Weight Percent	Total Sulfur Reduction, Weight Percent	Clean Coal Product, Weight Percent
Test No. 1, Run No. 2	2.26	22.6	93.1
Test No. 1, Run No. 3	2.36	16.5	97.0
Test No. 1, Run No. 4	2.11	22.3	75.6
Test No. 2, Run No. 1	2.35	24.7	88.0
Test No. 2, Run No. 2	2.47	21.1	91.4
Test No. 2, Run No. 3	2.57	24.5	89.3
Test No. 3, Run No. 3	2.00	10.0	97.7
Test No. 3, Run No. 4	3.05	29.5	95.4
Test No. 3, Run No. 5	2.28	20.6	95.7
Test No. 3, Run No. 6	2.39	27.6	90.9

* Based on Composite of Cyclone Products

Table 22 shows that the concentrating table did a better cleaning job than the compound water cyclone. It should be pointed out, however, that a closer-sized feed or feeds to the compound water cyclone, i.e., 30 mesh x 200 mesh and 200 mesh x 0, could have yielded improved results in total sulfur reduction.

The remaining four coals were precleaned on the concentrating table and second-stage cleaned in the compound water cyclone under two different sets of operating conditions. The results obtained with the first set of operating conditions are shown in Table 23. The data are plotted in Figure 32. Similar data are shown in Table 24 and Figure 33. The results from the No. 1 runs were far superior to those from the No. 2 runs; the recovery was much higher with approximately the same total sulfur reduction.

The complete data on the compound water cyclone test work can be found in Appendix C, Tables C-1 to C-30.

D. Concentrating Spiral

1. Description and Theory of Operation

The following description of the spiral and its theory of operation has been taken directly from one of the instruction manuals provided by the manufacturer of the concentrating spiral, as follows:

> The spiral is a conduit of modified semicircular cross section. Pulp is fed to the top and, as it flows downward, the heavier particles concentrate in a band along the inner side of the pulp stream. Ports for the removal of the heavy products are located at the lowest point in the cross section of the conduit. Wash water, added at the inner edge of the stream, flows outwardly across the concentrate band. The width of concentrate band removed at the ports is controlled by adjustable splitters. Concentrate (or refuse, when speaking of fine coal cleaning) is usually removed from the upper portion of the spiral and middling from the lower. Ore tailing (or clean coal) is discharged from the lower end of the spiral conduit. This lower end discharge may be divided by an adjustable splitter into two products: in ore separation, a slime tailing and a sand tailing; in coal separation, a clean coal product plus slime and a middling product. (Figure 34)

> The following comment is quoted from an article in March, 1945, Engineering and Mining Journal, pp. 85, 86, by George W. Gleeson, Dean, School of Engineering and Industrial Arts, Oregon State College, Corvallis, Oregon:

TABLE 23. CONCENTRATING TABLE AND COMPOUND WATER CYCLONE TESTS
EFFECTS OF TWO-STAGE CLEANING

Run No. 1 Operating Conditions

Coal Identification		Location	Total Sulfur,	Clean Coal,	Total Sulfur Reduction,
Lot	Seam	County, State	Feed to Table* Percent	Two-stage Cleaning Percent	Two-stage Cleaning Percent
2031	Lower Kittanning	Indiana, Pennsylvania	3.66	80.7	56.6
2026	No. 6	Columbiana, Ohio	2.90	87.9	45.2
2012	Upper Freeport	Westmoreland, Pennsylvania	3.30	78.7	56.7
2013	No. 8	Jefferson, Ohio	3.98	87.3	28.6

* Based on Composite of Table Products, Rough Cleaning

Run No. 1 Operating Conditions:
Cone Type "S," Vortex Finder Clearance: 1", Inlet Pressure: 5 psi, Feed Solids Concentration: 8.0%

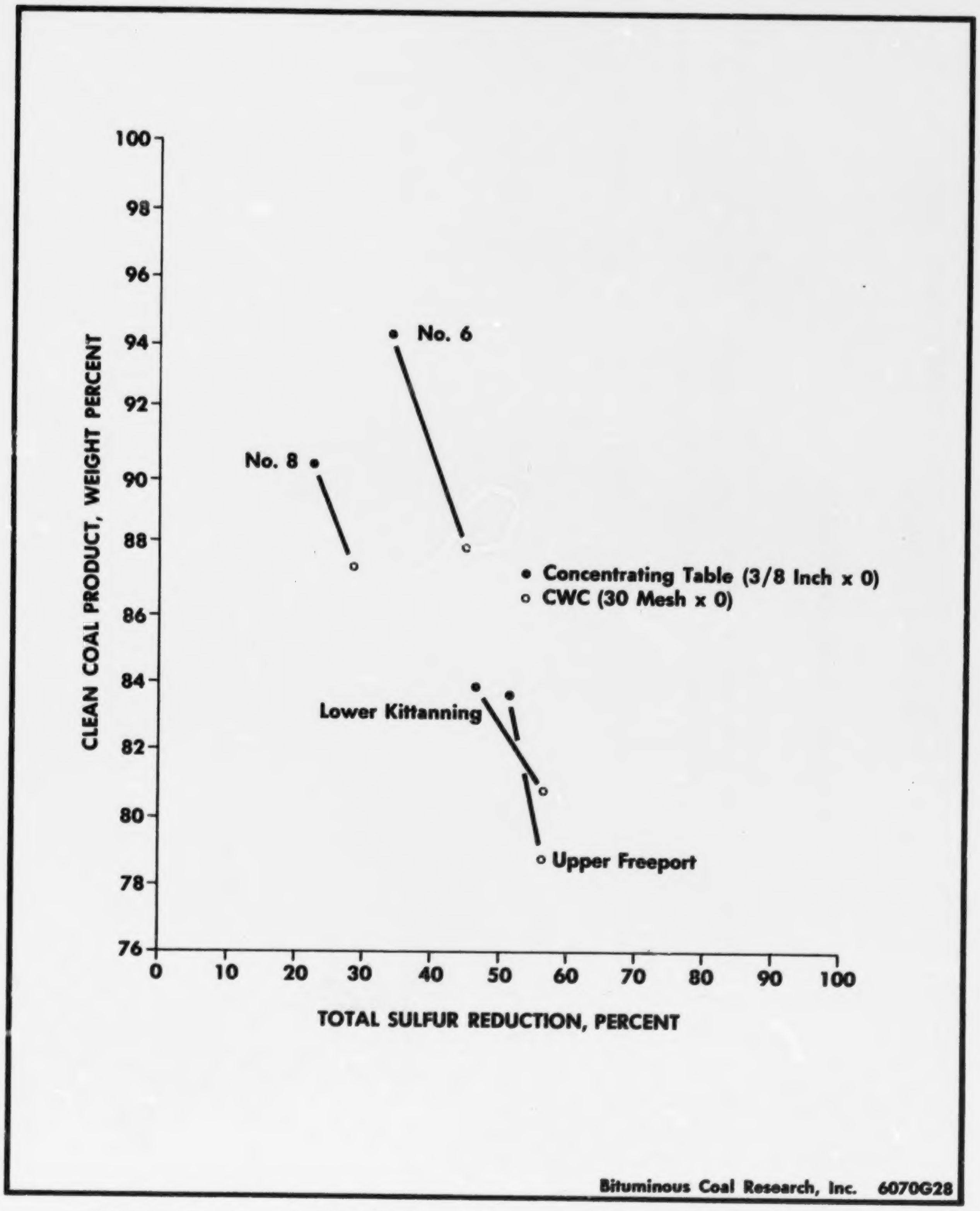


Figure 32. Compound Water Cyclone Tests—Effects of Two-stage Cleaning Run No. 1 Operating Conditions

TABLE 24. CONCENTRATING TABLE AND COMPOUND WATER CYCLONE TESTS EFFECTS OF TWO-STAGE CLEANING

Run No. 2 Operating Conditions

Coal Identification		Location	Total Sulfur Feed to Table*	Clean Coal Two-stage Cleaning	Total Sulfur Reduction, Two-stage Cleaning
Lot	Seam	County, State	Percent	Percent	Percent
2031	Lower Kittanning	Indiana, Pennsylvania	3.66	73.2	57.9
2026	No. 6	Columbiana, Ohio	2.90	80.3	44.8
2012	Upper Freeport	Westmoreland, Pennsylvania	3.30	69.9	62.7
2013	No. 8	Jefferson, Ohio	3.98	78.8	34.7

*Based on Composite of Table Products, Rough Cleaning

Run No. 2 Operating Conditions:
Cone Type "M", Vortex Finder Clearance: 1", Inlet Pressure: 8 psi, Feed Solids Concentration: 8.0%

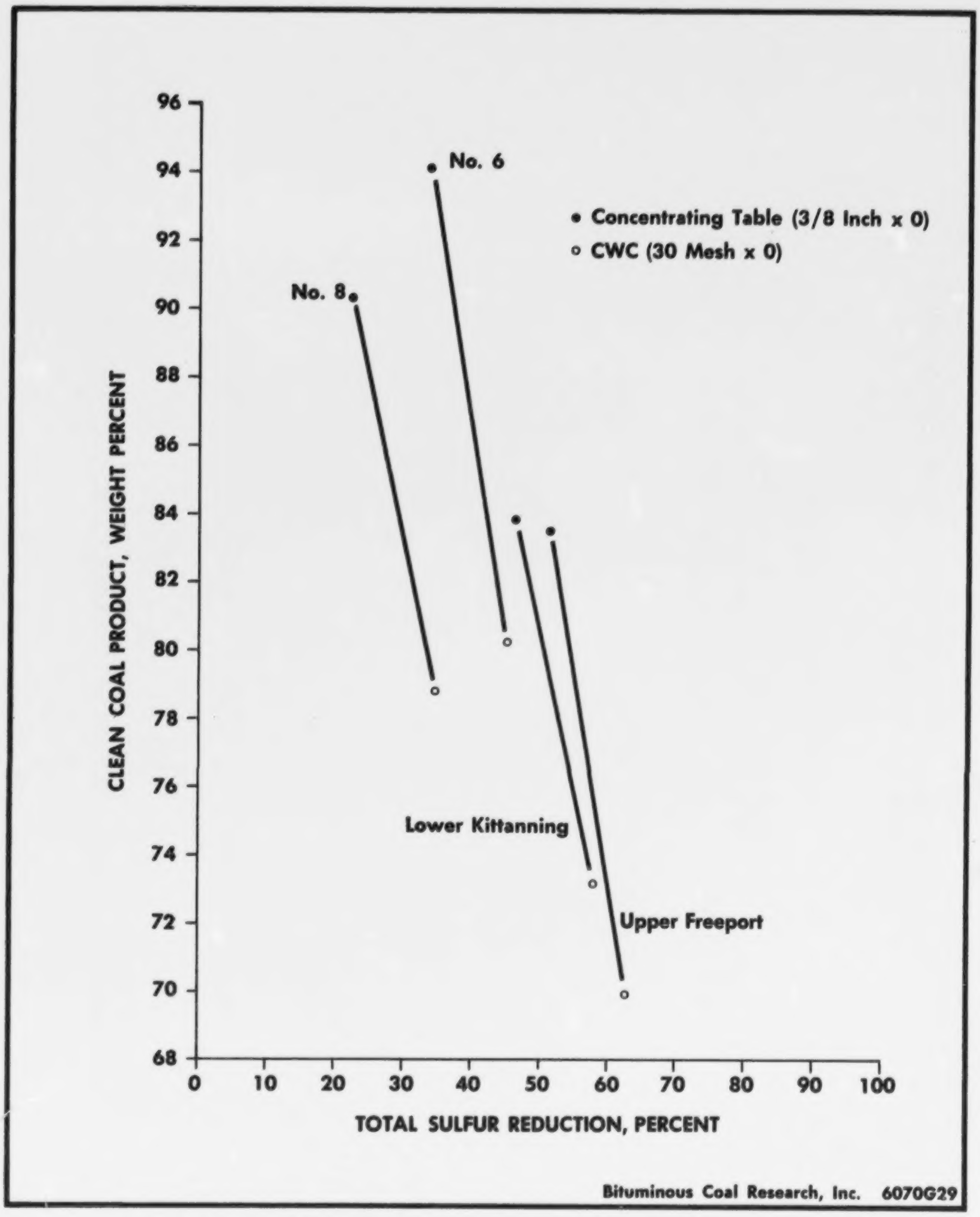


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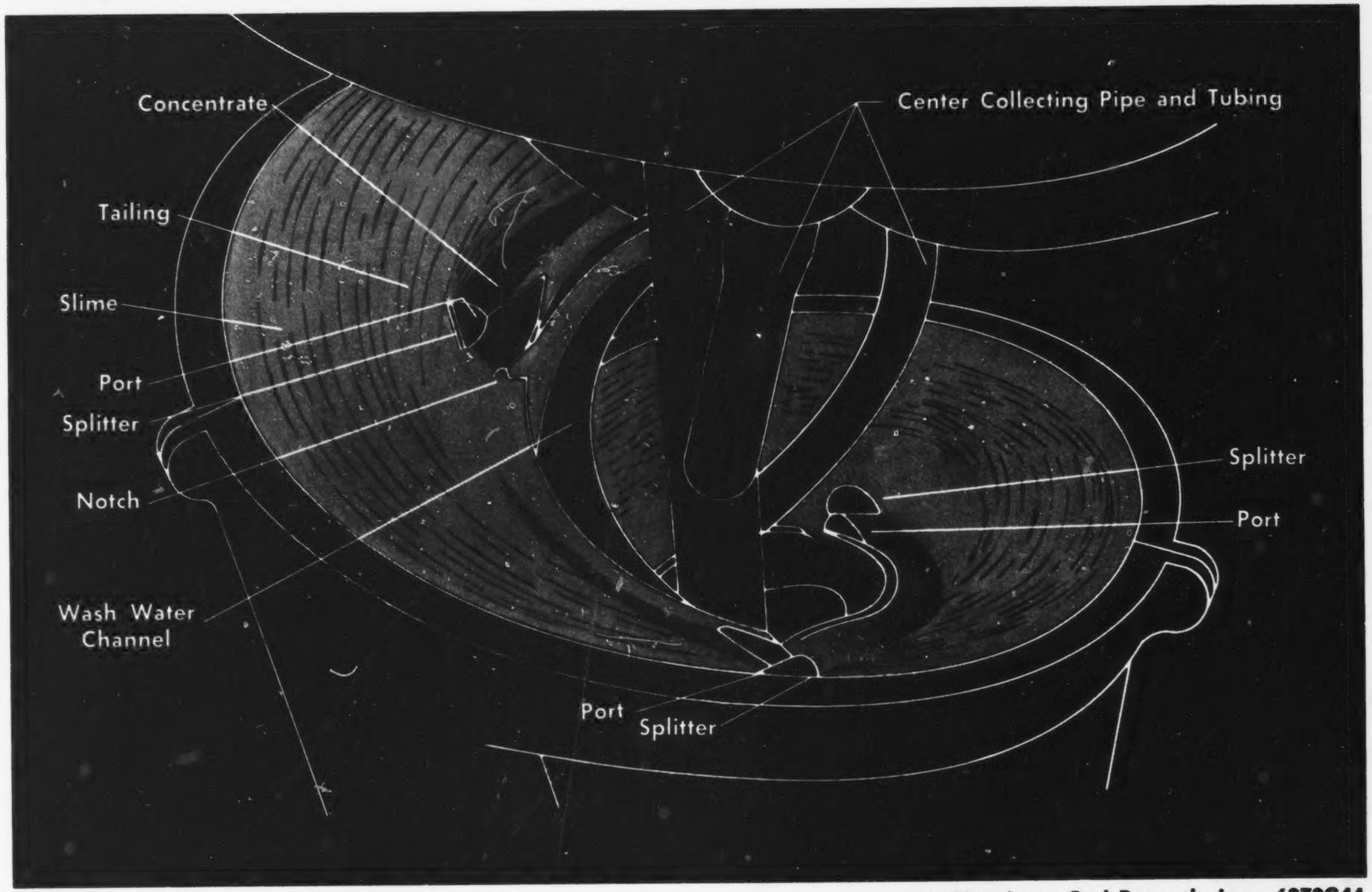
Figure 33. Compound Water Cyclone Tests—Effects of Two-stage Cleaning Run No. 2 Operating Conditions


Concentrate
Tailing
Slime
Port
Splitter
Notch
Wash Water Channel
Center Collecting Pipe and Tubing
Splitter
Port
Port
Splitter

Bituminous Coal Research, Inc. 6070G44

Figure 34. Action and Position of Products in the Spiral Concentrator

"Examination of the theory of operation of the spiral concentrator indicates why a device of such simplicity is capable in certain instances of a higher efficiency than more elaborate equipment.

As water flows down the spiral channel of modified semicircular section, each element will be subjected to a centrifugal force, tangential to the channel, directly proportional to the square of the velocity of flow and inversely proportional to the radius at which the element is located. This centrifugal force piles water up on the outer rim of the spiral until the flowing stream reaches an equilibrium between centrifugal force outward and gravitational force downward. Once established, the position of the stream is fairly constant for uniform pitch and radius.

Velocity of the spiral stream decreases with depth from its maximum just below the water surface until it approaches zero velocity at contact with the channel. The largest percentage decrease in velocity will occur nearest to the channel contact, giving rise to the 'fluid film' concept that is well developed in hydrodynamic literature.

In any curved channel, whether a pipe or a river bed, the bottom layer of water, retarded by friction, has much less centrifugal force and consequently will flow sidewise along the bottom toward the inner bank of the curved channel, carrying with it the heavier particles of sand. Simultaneously with this bottom flow of water inward, the upper mass of water must flow outward to replace it. There is, consequently, besides the flow of water down the length of the spiral, a flow of decreasing velocity downward and across the channel to the inside, then upward and across the channel to the inside, then upward and across the channel to the top, progressively increasing in velocity until friction again enters.

The foregoing rather complicated movement of the flowing stream has been well established as existing at all bends, and the spiral is simply an exaggeration of the more commonly encountered case. The several flows and forces combine to sort and concentrate any particles which may be suspended in the stream. Oddly enough, a limited size classification also takes place.

> The double spiral action in the flowing stream produces, as a final result, an idealized arrangement of particles of variable densities that is common to flowing-film type concentrators.
>
> Particle size, within limits, is not a critical factor, and no particular advantage is gained by prior classification. Once the idealized arrangement has been established, it is a simple matter to remove concentrate and middling through suitable openings located near the inner radius of the spiral.
>
> For particles of lower density, which sometimes are not entirely lifted into the main stream at the inner radius of the spiral, wash water is added at the inner edge of the stream. This wash water tends to wash off lighter material riding on the surface of the heavier and return it to the concentration zone."

2. Test Setup and Procedure

Testing with the concentrating spiral was conducted in an almost identical manner to that with the compound water cyclone. Batch tests were conducted utilizing the continuous mixing circuit devised for the compound water cyclone. An excellent overall view of the spiral can be seen in Figure 30. Three samples were obtained from the spiral; a clean coal product, a middling product, and a refuse product.

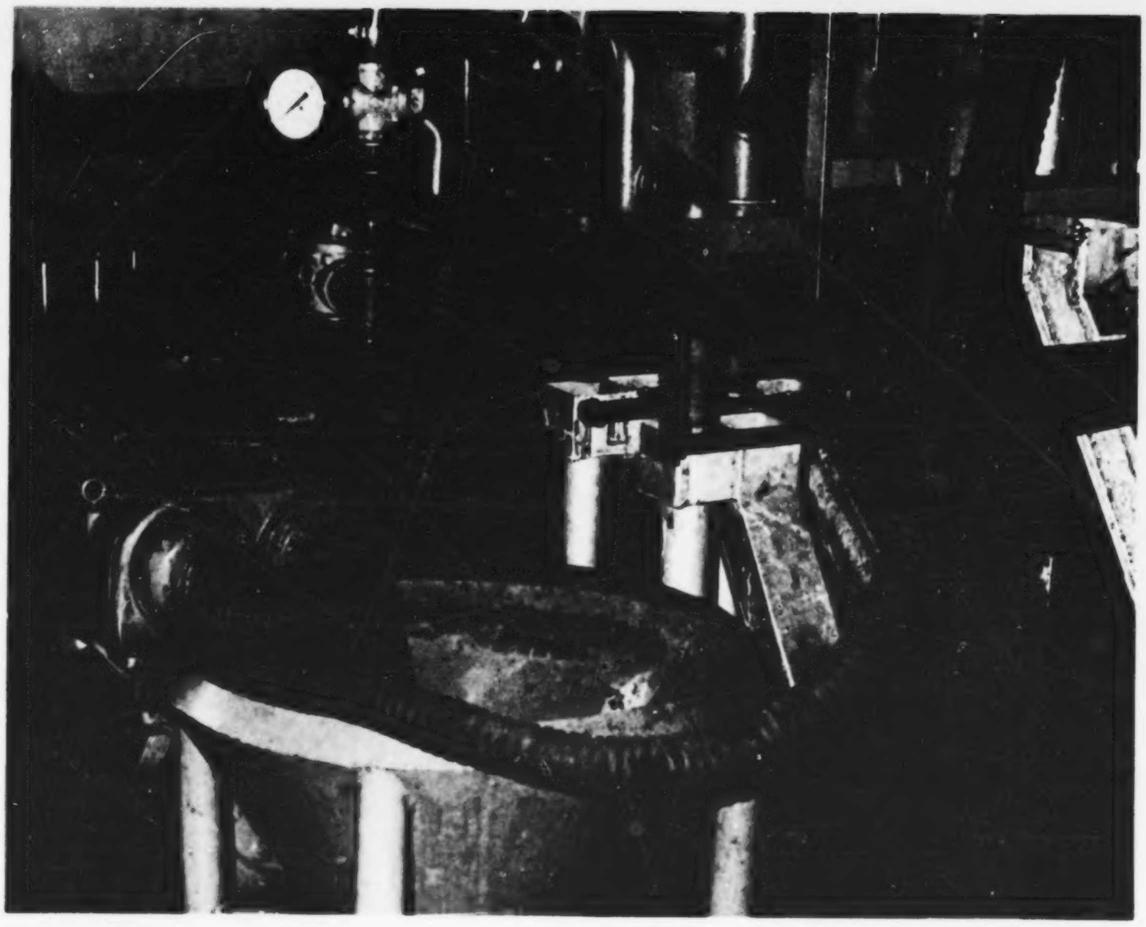
Figure 35 shows the pumping system and the three-pronged sampler directly behind the pump sump. The sampling flow sheet is shown in Figure 36. The clean coal and refuse fractions were handled the same as those from the cyclone tests.

The middling material was further processed in an attempt to take advantage of the reported concentration of fine clean coal and coarse refuse material when processing 1/4 inch x 0 coal with the spiral. A 100 mesh screen size was arbitrarily selected as the separating size, and both oversize and undersize were subjected to float-sink analyses.

Five different coals were subjected to spiral tests. The Ohio 6-A seam was tested at the 30 mesh x 0 size in the R.O.M. condition while the other four coals were precleaned on the concentrating table at the 3/8 inch x 0 size.

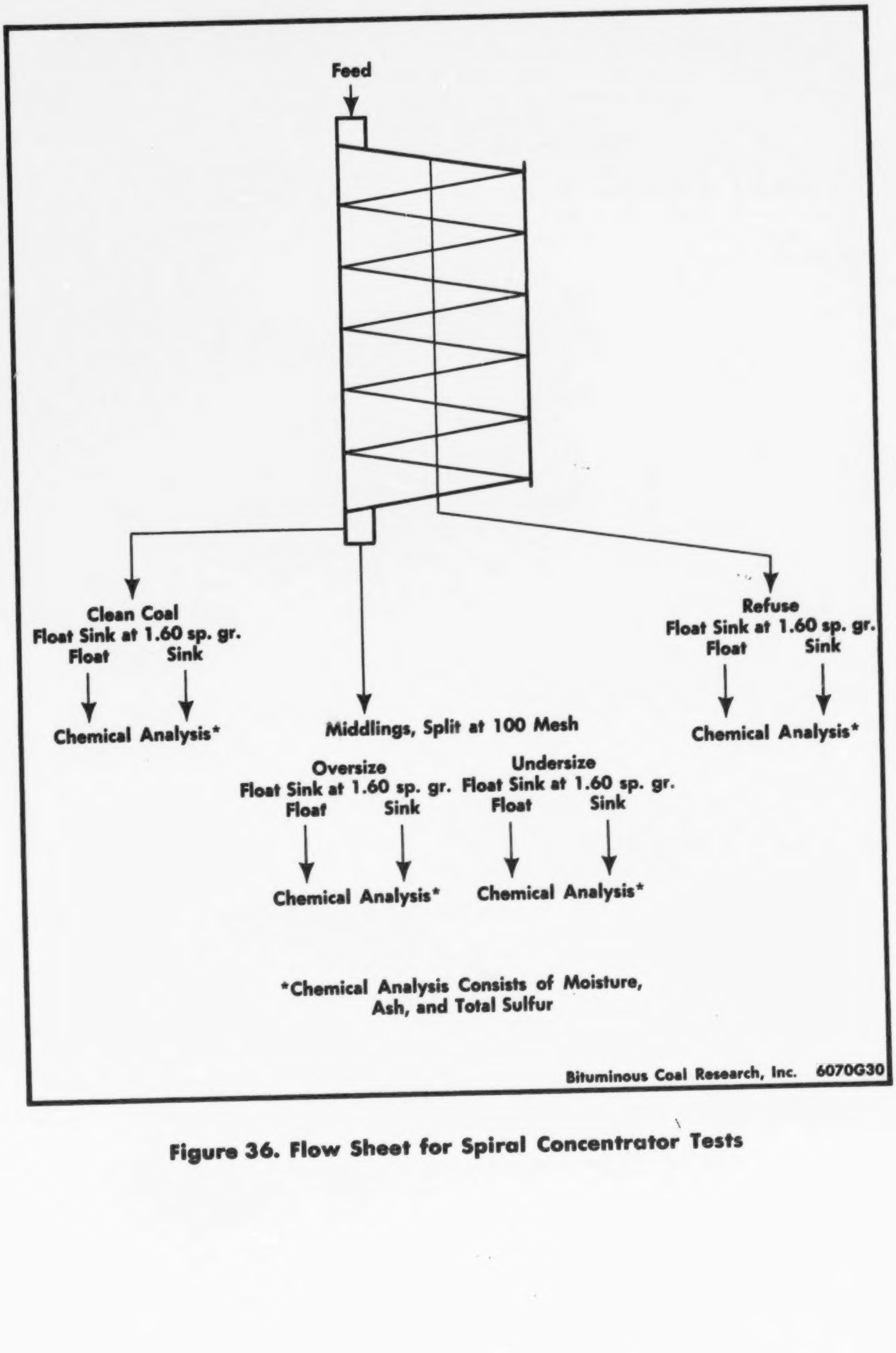
3. Summary of Results

In the single-stage cleaning of the 30 mesh x 0, R.O.M., Ohio No. 6-A coal, a 15.3 percent reduction in total sulfur was obtained with a recovery of 94.8 percent. This reduction and recovery were obtained



(6070P32)

Figure 35. View of Concentrating Spiral Pumping System


Feed
Clean Coal
Float Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*
Middlings, Split at 100 Mesh
Oversize
Float Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*
Undersize
Float Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*
Refuse
Float Sink at 1.60 sp. gr.
Float
Sink
Chemical Analysis*

*Chemical Analysis Consists of Moisture, Ash, and Total Sulfur

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Figure 36. Flow Sheet for Spiral Concentrator Tests

by combining both complete screen fractions of the middling material with the clean coal, as shown in Table 25. The data shown are typical for the four subsequent spiral runs utilizing two-stage cleaning. All clean coal fractions contained a significant quantity of high ash, high sulfur sink material. The middling oversize was cleaner than the undersize. The refuse never exceeded 50 percent in 1.60 sink material. Table 26 shows the total sulfur reduction and recovery obtained with the four coals that had been precleaned on the concentrating table at the 3/8 inch x 0 size. The data are shown graphically in Figure 37. All test data for the concentrating spiral are contained in Appendix D, Tables D-1 to D-13.

TABLE 25. SAMPLE COPY OF SPIRAL CONCENTRATOR TEST DATA SHEET

Evaluation of Coal Cleaning Process and Techniques
for Removing Pyritic Sulfur from Fine Coal

Spiral Concentrator Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0

BCR Sample No. 1950

Operating Conditions:

Splitter Nos.	9-2, 12-2, 15-2	Specific Gravity, Pulp	1.07
Inlet Pressure, psi	9	Flowrate of Pulp, usgpm	21.6
Dry Feed, tph	1.1	Weight Percent, Solids	24.6
Middling Split, mesh	100	Specific Gravity, Solids	1.40

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal				
Float at 1.60	69.3	94.8	6.30	1.14
Sink at 1.60	3.8	5.2	39.30	9.46
Composite	73.1	100.0	8.0	1.57
Middling Oversize				
Float at 1.60	13.9	93.7	6.13	1.25
Sink at 1.60	0.9	6.3	39.40	6.70
Composite	14.8	100.0	8.02	1.59
Middling Undersize				
Float at 1.60	6.0	87.0	6.76	1.00
Sink at 1.60	0.9	13.0	53.20	14.20
Composite	6.9	100.0	12.80	2.72
Refuse				
Float at 1.60	2.9	55.8	7.32	1.32
Sink at 1.60	2.3	44.2	65.80	15.40
Composite	5.2	100.0	33.17	7.54
Composite of Concentrator Products	100.0		9.69	1.96
Analysis of Feed to Concentrator			11.20	2.54

Run Date: 11-25-68

15.3 % Reduction in Total Sulfur at 94.8% Recovery.
* This table is identical to Table D-1, Appendix D.

TABLE 26. CONCENTRATING TABLE AND SPIRAL CONCENTRATOR TESTS
EFFECTS OF TWO-STAGE CLEANING

Coal Identification Lot	Seam	Location County, State	Total Sulfur, Feed to Table* Percent	Clean Coal, Two-stage Cleaning Percent	Total Sulfur Reduction, Two-stage Cleaning Percent
2031	Lower Kittanning	Indiana, Pennsylvania	3.66	78.3	65.3
2026	No. 6	Columbiana, Ohio	2.90	89.3	48.3
2012	Upper Freeport	Westmoreland, Pennsylvania	3.30	77.9	54.5
2013	No. 8	Jefferson, Ohio	3.98	87.0	28.4

* Based on Composite of Table Products, Rough Cleaning

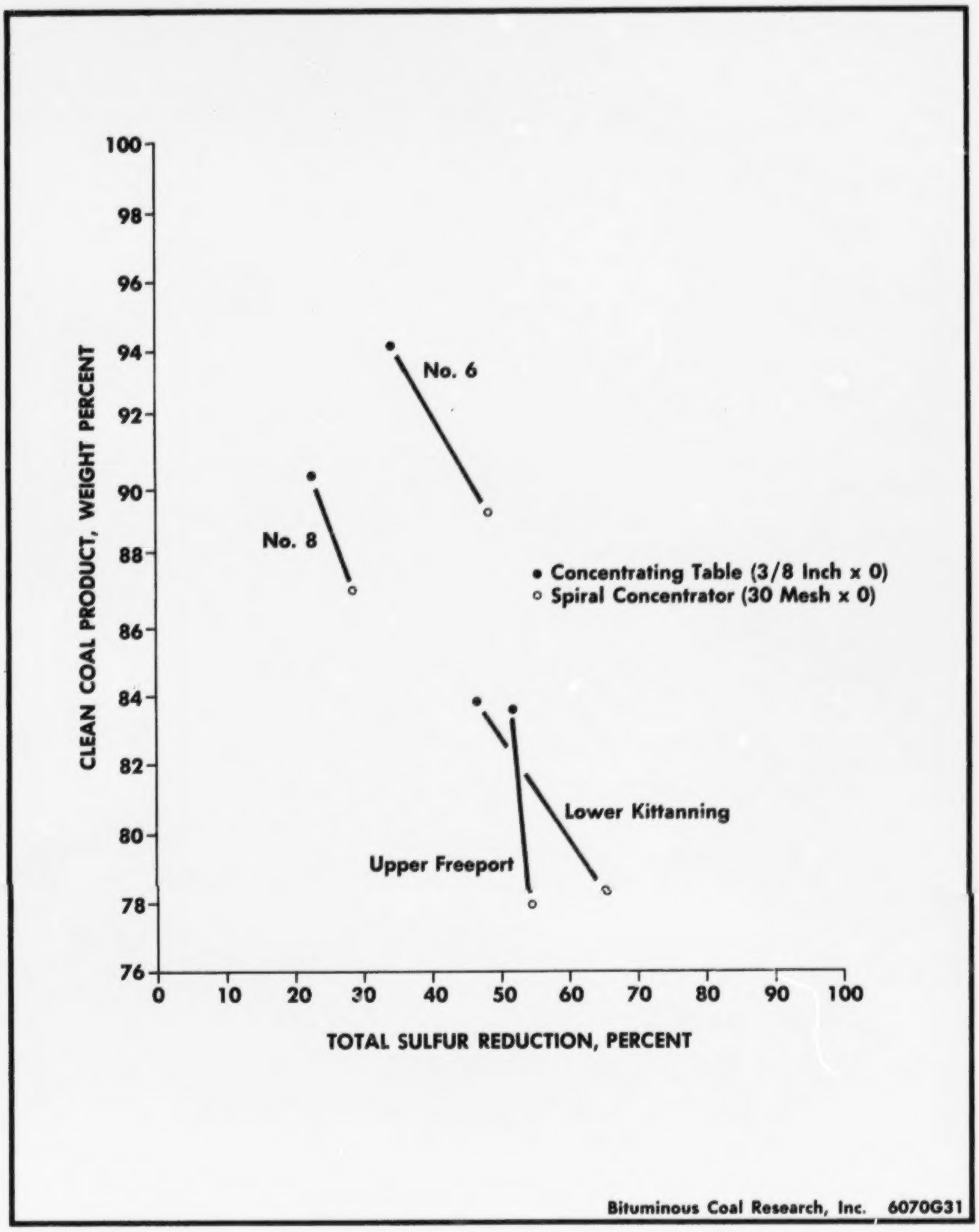

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Figure 37. Spiral Concentrator Tests—Effects of Two-stage Cleaning

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V. PHASE III EVALUATIONS

A. Test Procedure

The use of air classification as a means of removing pyrite from the feed to the burners at power stations is an area of research work pioneered by BCR. The process involves the air separation of a relatively coarse grind of pulverized coal into a fine fraction suitable for firing and a coarse, pyrite-rich fraction that requires further processing. The pyrite can be removed from this coarse fraction using conventional, wet-coal preparation equipment. The coarse, clean coal fraction produced could then be further pulverized to produce additional burner feed. While this is an oversimplification of the BCR process, it does outline the laboratory tests used to evaluate the suitability of ten different coals selected from the first 30 tested in the Phase I evaluations of this process.

Coal rank, level of sulfur reduction, seam importance, and the producing company were all considered in selecting the coals for the Phase III work.

The following two parameters were established to control the pulverization of the coal and the air separation in the classifier.

1. The coarse fraction had to be between 30 and 40 percent of the feed. This represents a reasonable quantity to remove for wet cleaning, so that the cleaned, dewatered fraction could be added directly back to the pulverizer without thermal drying.

2. The fine fraction had to be similar to the pulverized coal grind used at power stations.

Both coarse and fine fractions were subjected to float-sink tests at 1.60 specific gravity. Recovery and analyses of the final, clean coal product were obtained by compositing the coarse, clean coal fractions with both fine coal fractions.

All ten air classification tests were conducted utilizing the BCR-Majac air classifier shown in Figure 38.

One of the coals was also air-classified in an Alpine Zigzag air classifier shown in Figures 39 and 40.

B. Summary of Results

Table 27 presents the results of the ten Majac air classification tests for total sulfur reduction while Table 28 presents the same information for pyritic sulfur reduction. Both sets of information are combined into a graphic portrayal, Figure 41.

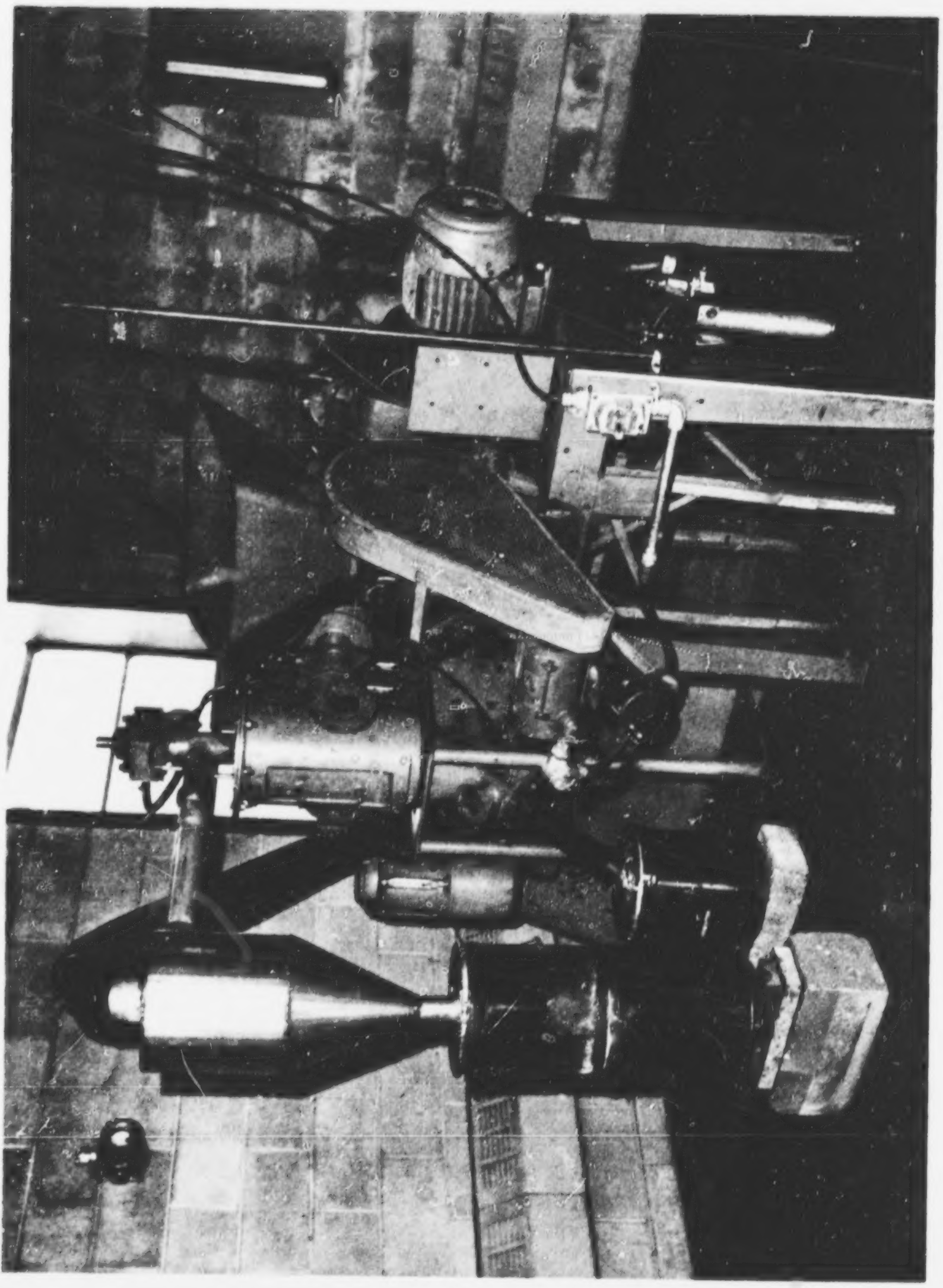

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Figure 38. View of BCR-Majac Air Classifier

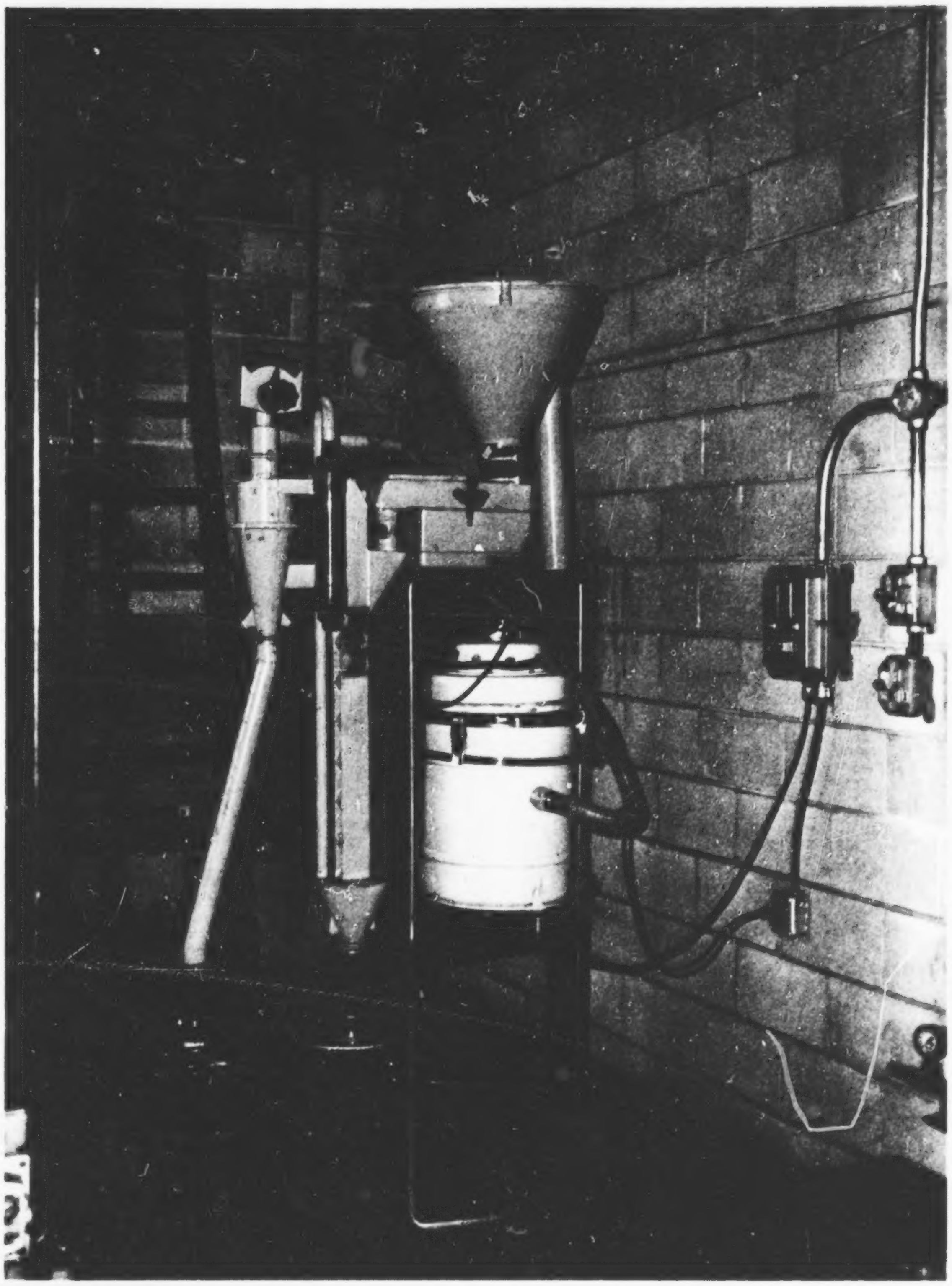

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Figure 39. Front View of Alpine Zigzag Air Classifier

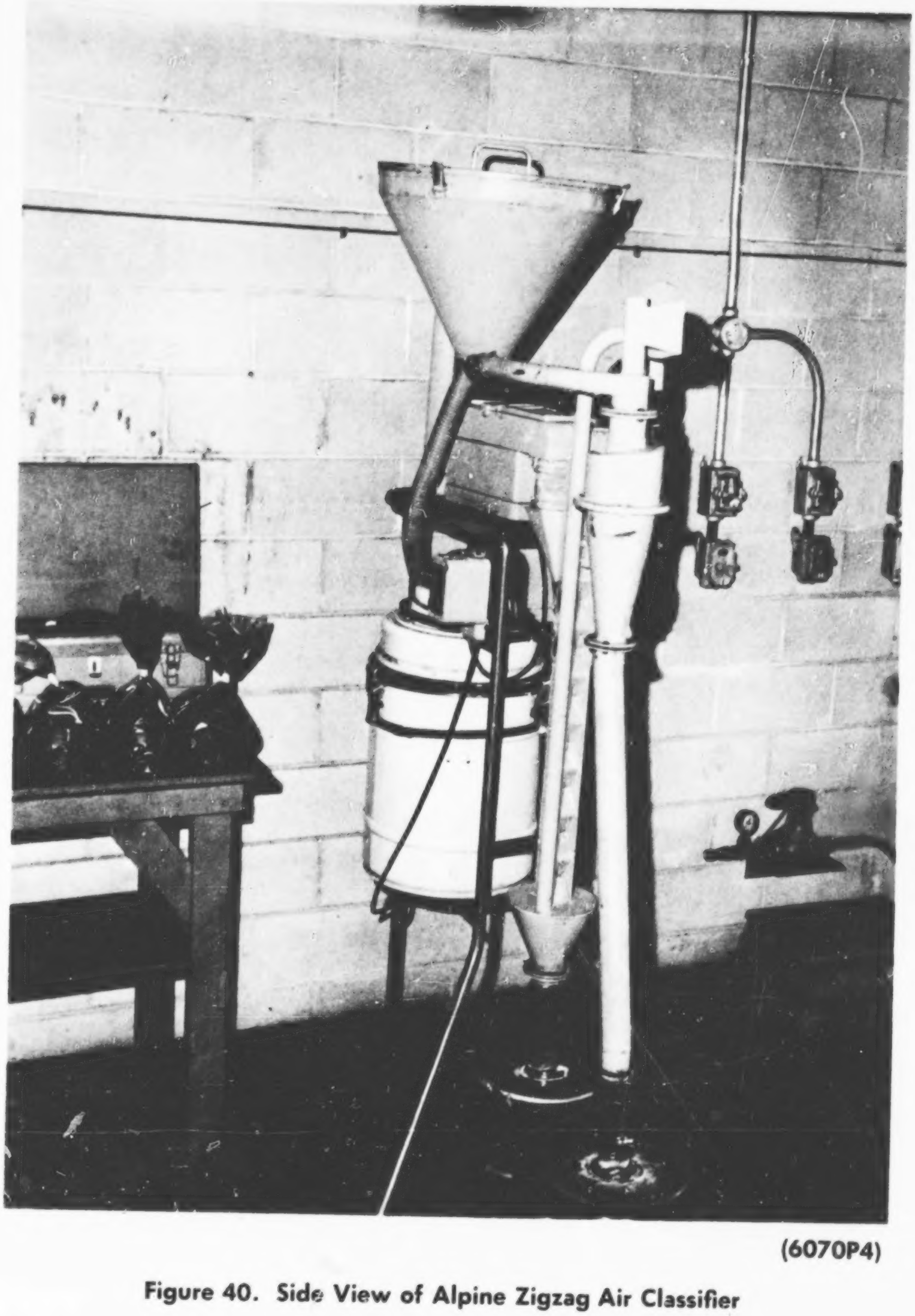

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Figure 40. Side View of Alpine Zigzag Air Classifier

TABLE 27. TOTAL SULFUR REDUCTION IN MAJAC AIR CLASSIFICATION TESTS

BCR Lot No.	Seam	Rank	Total Sulfur in Raw Coal Percent	Recovery Majac Product Percent	Total Sulfur in Majac Product* Percent	Total Sulfur Reduction Percent
1752	Upper Kittanning	LV	2.71	90.4	1.31	51.7
1750	Upper Freeport	HVA	3.74	83.6	1.98	47.1
1771	Lower Freeport	HVA	2.54	92.6	1.49	41.3
1745	No. 6	HVB	2.44	94.3	1.46	40.2
1770	Thick Freeport	HVB	2.08	90.9	1.25	39.1
1735	No. 6-A	HVB	2.50	93.2	1.65	34.0
1730	No. 6	HVC	4.72	92.2	3.16	33.1
1747	Lower Kittanning and Lower Freeport	MV	2.42	90.7	1.65	31.8
1757	Freeport	MV	2.52	77.5	1.90	24.6
1733	No. 8	HVC	4.58	87.6	3.66	20.1

*Majac product composed of raw fine coal plus cleaned coarse fraction (1.60 specific gravity)

TABLE 28. PYRITIC SULFUR REDUCTION IN MAJAC AIR CLASSIFICATION TESTS

BCR Lot No.	Seam	Rank	Pyritic Sulfur in Raw Coal, Percent	Recovery Majac Product, Percent	Pyritic Sulfur in Majac Product,* Percent	Pyritic Sulfur Reduction, Percent
1752	Upper Kittanning	LV	2.31	90.4	0.94	59.3
1750	Upper Freeport	HVA	3.22	83.6	1.48	54.0
1771	Lower Freeport	HVA	1.89	92.6	0.98	48.1
1745	No. 6	HVB	1.79	94.3	1.01	43.6
1770	Thick Freeport	HVB	1.68	90.9	0.92	45.2
1735	No. 6-A	HVB	1.86	93.2	0.98	47.3
1730	No. 6	HVC	3.70	92.2	2.17	41.4
1747	Lower Kittanning and Lower Freeport	MV	1.84	90.7	1.08	41.3
1757	Freeport	MV	2.16	77.5	1.39	35.6
1733	No. 8	HVC	2.84	87.6	1.95	31.3

* Majac product composed of raw fine coal plus cleaned coarse fraction (1.60 specific gravity)

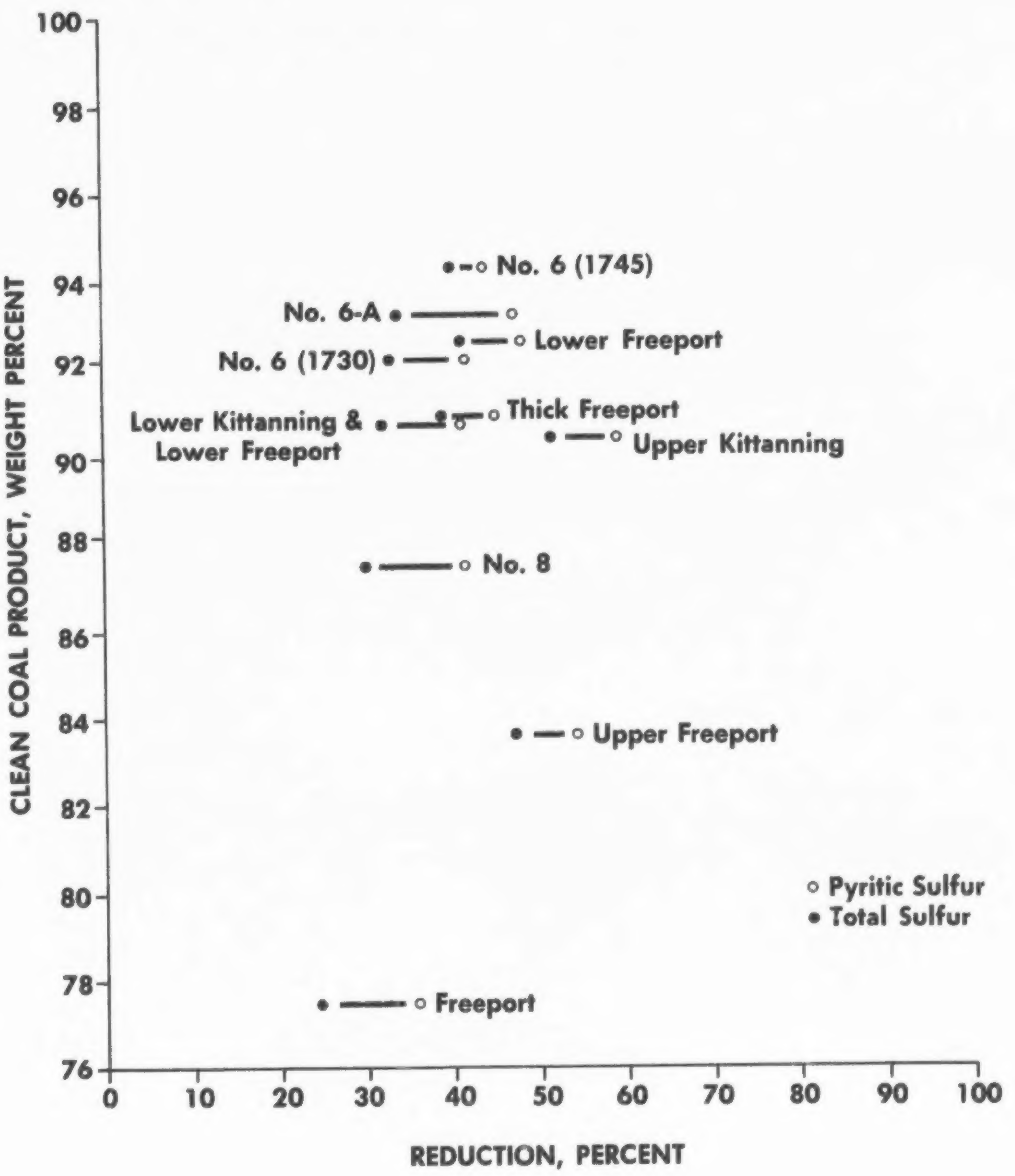

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Figure 41. Results of BCR-Majac Air Classification Tests

The results of the Alpine Zigzag classification tests are shown in Table 29, and these data indicate that this classifier compares favorably to the Majac in efficiency of separation with the one coal tested.

The complete data from the Phase III testwork can be found in Appendix E, Tables E-1 to E-12.

TABLE 29. SULFUR REDUCTION IN ALPINE ZIGZAG CLASSIFIER TESTS

A--Total Sulfur Reduction

BCR Lot No.	Seam	Rank	Total Sulfur in Raw Coal, Percent	Zigzag Product, Percent	Total Sulfur in Zigzag Product,* Percent	Total Sulfur Reduction, Percent
1733	No. 8	HVC	4.58	84.1	3.82	16.6

* Zigzag product composed of raw fine coal plus cleaned coarse fraction (1.60 specific gravity)

B--Pyritic Sulfur Reduction

BCR Lot No.	Seam	Rank	Pyritic Sulfur in Raw Coal, Percent	Zigzag Product, Percent	Pyritic Sulfur in Zigzag Product,** Percent	Pyritic Sulfur Reduction, Percent
1733	No. 8	HVC	2.84	84.1	1.90	33.1

** Zigzag product composed of raw fine coal plus cleaned coarse fraction (1.60 specific gravity)

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TABLE A-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification PITTSBURGH SEAM, MARION COUNTY, WEST VIRGINIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1725

Chemical Analysis, As Received:

Weight %, Dry Basis

Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.15	9.46	38.2	52.3	2.3	0.03	1.07	1.20	13,677

Analyses of As-received Sample Reduced to Minus 30 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.1	5.22	1.57	0.36	66.4	31.7
Sink at 1.60	12.9	40.2	7.98	7.00		
Composite	100.0	9.73	2.40	1.22		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.2	5.00	1.42	0.23	78.5	38.3
Sink at 1.60	13.8	38.8	7.98	7.14		
Composite	100.0	9.66	2.33	1.18		

TABLE A-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 9 SEAM MINE, MORGAN COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1728

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
3.29	21.4	38.1	40.5	5.35	0.04	2.92	2.39	11,072

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	74.4	10.6	3.98	1.14	60.1	27.1
Sink at 1.60	25.6	51.2	9.46	7.89		
Composite	100.0	20.99	5.38	2.87		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	73.4	9.73	3.66	0.79	72.4	33.0
Sink at 1.60	26.6	51.6	9.56	8.20		
Composite	100.0	20.87	5.23	2.76		

TABLE A-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6, 7, and 8 SEAM, ATHENS COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1729

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
4.56	10.9	42.8	46.3	4.60	0.04	2.82	1.74	12,638

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.0	4.69	2.86	0.90	68.1	37.8
Sink at 1.60	14.0	47.2	15.4	14.5		
Composite	100.0	10.64	4.62	2.81		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.3	4.54	2.44	0.54	80.9	47.0
Sink at 1.60	14.7	44.7	16.6	15.4		
Composite	100.0	10.44	4.52	2.72		

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TABLE A-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, PERRY COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1730

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
5.22	19.5	38.8	41.7	4.72	0.05	3.70	1.00	11,143

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	72.4	7.24	1.89	0.70	81.1	60.0
Sink at 1.60	27.6	49.6	12.4	11.0		
Composite	100.0	18.93	4.79	3.54		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	71.8	7.07	1.74	0.55	81.5	63.1
Sink at 1.60	28.2	52.8	13.1	12.7		
Composite	100.0	19.97	4.94	3.98		

TABLE A-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 8 SEAM, BELMONT COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1733

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.18	26.6	35.4	38.0	4.58	0.04	2.84	1.70	10,575

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	67.3	7.12	3.37	1.14	59.1	26.4
Sink at 1.60	32.7	69.0	7.64	7.00		
Composite	100.0	27.35	4.77	3.06		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	65.1	7.38	2.90	0.73	74.3	36.7
Sink at 1.60	34.9	61.9	7.56	6.75		
Composite	100.0	26.41	4.53	2.83		

TABLE A-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1734

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.34	9.44	37.9	52.7	2.18	0.01	1.42	0.75	13,395

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.8	4.67	1.14	0.33	76.8	47.7
Sink at 1.60	11.2	42.8	9.36	8.80		
Composite	100.0	8.94	2.06	1.28		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.5	4.75	0.96	0.18	87.3	56.0
Sink at 1.60	12.5	41.8	9.90	9.50		
Composite	100.0	9.38	2.17	1.35		

TABLE A-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1735

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.92	10.4	38.4	51.2	2.50	0.01	1.86	0.63	13,234

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.6	4.42	0.90	0.32	82.8	64.0
Sink at 1.60	13.4	53.4	11.5	11.2		
Composite	100.0	10.98	2.32	1.78		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.9	4.37	0.78	0.15	91.9	69.8
Sink at 1.60	14.1	49.9	12.8	12.3		
Composite	100.0	10.79	2.47	1.86		

TABLE A-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5-A SEAM, JEFFERSON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1743

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.79	17.2	37.6	45.2	3.90	0.16	3.08	0.66	12,232

Analyses of As-received Sample Reduced to Minus 30 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	78.4	6.77	1.74	0.88	71.4	55.4
Sink at 1.60	21.6	59.5	11.8	11.1		
Composite	100.0	18.16	3.91	3.09		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.4	6.42	1.46	0.59	80.8	62.6
Sink at 1.60	22.6	54.4	12.8	12.5		
Composite	100.0	17.26	4.02	3.28		

TABLE A-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 4 SEAM, MAHONING COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1744

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
3.22	7.58	38.6	53.82	2.54	0.04	1.80	0.70	13,644

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	89.3	3.40	0.90	0.33	81.7	64.6
Sink at 1.60	10.7	40.4	14.6	13.7		
Composite	100.0	7.36	2.37	1.76		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.2	3.22	0.82	0.23	87.2	67.7
Sink at 1.60	11.8	40.6	14.6	13.8		
Composite	100.0	7.63	2.45	1.83		

TABLE A-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1745

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.34	10.4	37.5	52.10	2.44	0.05	1.79	0.60	13,333

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.7	4.73	0.76	0.32	82.1	68.9
Sink at 1.60	14.3	44.6	12.1	11.9		
Composite	100.0	10.43	2.38	1.98		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.8	4.02	0.59	0.14	92.2	75.8
Sink at 1.60	16.2	45.1	12.8	12.2		
Composite	100.0	10.67	2.57	2.09		

TABLE A-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, CAMBRIA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1746

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.58	24.8	19.7	55.50	1.14	<0.01	0.90	0.24	11,594

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	67.7	7.6	0.61	0.21	76.7	46.5
Sink at 1.60	32.3	60.9	2.52	2.43		
Composite	100.0	24.82	1.23	0.93		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	66.7	6.7	0.55	0.11	87.8	51.8
Sink at 1.60	33.3	61.8	2.58	2.47		
Composite	100.0	25.05	1.23	0.92		

TABLE A-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING AND LOWER FREEPORT SEAM,
CAMBRIA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1747

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.54	13.3	22.3	64.40	2.42	0.02	1.84	0.56	13,434

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.6	4.88	0.92	0.31	83.2	62.0
Sink at 1.60	18.4	58.8	9.53	9.16		
Composite	100.0	14.80	2.50	1.94		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.6	4.35	0.75	0.17	90.8	69.0
Sink at 1.60	20.4	57.6	9.78	9.53		
Composite	100.0	15.21	2.59	2.08		

TABLE A-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1748

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.46	13.8	24.2	62.00	4.90	0.05	4.14	0.71	13,356

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	82.1	5.44	1.79	1.02	75.4	63.5
Sink at 1.60	17.9	50.5	17.7	17.3		
Composite	100.0	13.51	4.64	3.93		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.1	4.62	1.47	0.69	83.3	70.0
Sink at 1.60	18.9	51.4	18.8	18.5		
Composite	100.0	13.46	4.75	4.06		

TABLE A-14

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, CAMBRIA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1749

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.66	12.6	20.3	67.10	1.50	0.02	0.94	0.54	13,606

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.6	5.10	0.70	0.15	84.0	53.3
Sink at 1.60	16.4	48.8	5.07	4.93		
Composite	100.0	12.27	1.42	0.93		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.8	4.46	0.66	0.08	91.5	56.0
Sink at 1.60	18.2	46.4	4.52	4.50		
Composite	100.0	12.09	1.36	.88		

TABLE A-15

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1750

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.75	22.5	29.8	46.70	3.74	0.03	3.22	0.49	11,704

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	70.2	5.06	1.07	0.57	82.3	71.4
Sink at 1.60	29.8	64.6	10.4	10.31		
Composite	100.0	22.80	3.85	3.47		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	70.8	5.49	0.87	0.36	88.8	76.7
Sink at 1.60	29.2	62.0	10.5	10.2		
Composite	100.0	21.99	3.68	3.23		

TABLE A-16

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER FREEPORT SEAM, INDIANA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1751

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.53	14.4	22.2	63.40	1.83	<0.01	1.31	0.52	13,322

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.8	5.36	0.78	0.28	78.6	57.4
Sink at 1.60	19.2	54.2	5.80	5.73		
Composite	100.0	14.74	1.74	1.33		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.9	4.97	0.68	0.20	84.7	62.8
Sink at 1.60	20.1	53.4	5.90	5.95		
Composite	100.0	14.70	1.73	1.36		

TABLE A-17

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1752

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.64	15.4	17.6	67.00	2.71	0.02	2.31	0.38	13,030

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.9	6.33	0.54	0.16	93.1	80.1
Sink at 1.60	19.1	55.6	12.1	12.2		
Composite	100.0	15.74	2.75	2.46		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.5	5.94	0.50	0.14	93.9	81.5
Sink at 1.60	20.5	53.0	11.2	11.3		
Composite	100.0	15.59	2.69	2.43		

TABLE A-18

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification **LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA**
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1755

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.61	20.1	22.2	57.70	4.66	0.05	4.00	0.61	12,273

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	70.6	5.26	1.32	0.55	86.2	71.7
Sink at 1.60	29.4	62.00	14.4	14.5		
Composite	100.0	21.94	5.17	4.75		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	72.1	4.68	1.18	0.38	90.5	74.7
Sink at 1.60	27.9	59.2	13.5	13.2		
Composite	100.0	19.89	4.62	3.96		

TABLE A-19

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1756

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.54	14.8	22.1	63.10	5.20	0.04	4.56	0.60	13,110

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	76.2	5.08	1.52	0.79	82.7	70.8
Sink at 1.60	23.8	55.1	19.5	19.31		
Composite	100.0	16.98	5.80	5.20		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	78.6	4.54	1.26	0.52	88.6	75.8
Sink at 1.60	21.4	52.0	19.1	18.4		
Composite	100.0	14.70	5.08	4.35		

TABLE A-20

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification FREEPORT SEAM, GRANT COUNTY, WEST VIRGINIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1757

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.70	32.4	16.0	51.60	2.52	0.02	2.16	0.34	10,143

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	55.9	10.4	1.08	0.52	75.9	57.1
Sink at 1.60	44.1	67.1	4.60	4.57		
Composite	100.0	35.40	2.63	2.31		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	57.9	9.83	0.91	0.31	85.6	63.9
Sink at 1.60	42.1	65.6	4.60	4.55		
Composite	100.0	33.31	2.46	2.09		

TABLE A-21

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 8 SEAM, HARRISON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1762

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.64	13.0	40.2	46.80	3.64	0.03	2.32	1.29	12,580

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.2	5.78	2.13	0.78	66.4	41.5
Sink at 1.60	16.8	53.0	12.8	11.5		
Composite	100.0	13.71	3.92	2.58		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.8	5.22	1.84	0.53	77.2	49.5
Sink at 1.60	18.2	43.7	10.7	9.90		
Composite	100.0	12.22	3.45	2.24		

TABLE A-22

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification **FREEPORT SEAM, PRESTON COUNTY, WEST VIRGINIA**
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1763

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.52	14.3	26.7	59.00	1.52	0.02	0.98	0.52	13,034

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.5	6.08	0.62	0.16	83.7	59.2
Sink at 1.60	18.5	54.6	5.46	5.42		
Composite	100.0	15.06	1.52	1.13		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	82.1	5.52	0.58	0.14	85.7	61.8
Sink at 1.60	17.9	53.0	5.05	5.00		
Composite	100.0	14.02	1.38	1.01		

TABLE A-23

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification BAKERSTOWN SEAM, GRANT COUNTY, WEST VIRGINIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1764

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.04	29.4	19.6	51.00	3.04	0.01	2.85	0.18	10,696

Analyses of As-received Sample Reduced to Minus 30 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	60.3	10.6	0.72	0.28	90.2	76.3
Sink at 1.60	39.7	60.3	7.03	6.90		
Composite	100.0	30.33	3.23	2.91		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	61.9	9.82	0.68	0.21	92.6	77.6
Sink at 1.60	38.1	59.3	6.24	5.70		
Composite	100.0	28.67	2.80	2.30		

TABLE A-24

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1765

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.74	13.0	37.6	49.40	3.36	0.04	2.26	1.06	12,638

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.8	6.03	2.24	1.10	51.3	33.3
Sink at 1.60	16.2	56.4	9.88	9.30		
Composite	100.0	14.19	3.48	2.42		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.8	5.78	1.81	0.68	69.9	46.1
Sink at 1.60	19.2	47.5	10.36	9.40		
Composite	100.0	13.79	3.45	2.35		

TABLE A-25

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 9 SEAM, BELMONT COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1766

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.68	13.8	39.1	47.10	3.02	0.02	1.88	1.12	12,520

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	89.4	10.3	1.93	0.77	59.0	36.1
Sink at 1.60	10.6	44.5	13.2	11.9		
Composite	100.0	13.93	3.12	1.95		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.5	9.40	1.64	0.48	74.5	45.7
Sink at 1.60	13.5	40.7	11.67	10.1		
Composite	100.0	13.63	2.99	1.78		

TABLE A-26

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, COSHOCTON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1767

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
5.69	8.88	41.8	49.32	3.70	0.08	2.09	1.53	12,726

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.7	3.64	2.42	0.62	70.3	34.5
Sink at 1.60	12.3	51.1	14.2	12.7		
Composite	100.0	9.48	3.87	2.11		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.9	3.81	2.34	0.60	71.3	36.8
Sink at 1.60	14.1	38.6	11.78	9.16		
Composite	100.0	8.72	3.67	1.81		

TABLE A-27

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1768

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.48	19.4	35.2	45.40	4.71	0.07	3.69	0.95	11,665

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	74.0	8.62	2.79	1.60	56.6	40.8
Sink at 1.60	26.0	57.4	11.1	10.6		
Composite	100.0	21.30	4.95	3.94		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	73.8	7.54	2.09	0.95	74.3	55.6
Sink at 1.60	26.2	54.3	12.18	11.0		
Composite	100.0	19.79	4.73	3.58		

TABLE A-28

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification THICK FREEPORT SEAM, ALLEGHENY COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1770

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.52	22.0	32.4	45.60	2.08	0.05	1.68	0.35	11,635

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	71.7	7.03	0.70	0.30	82.1	66.3
Sink at 1.60	28.3	63.0	5.92	5.83		
Composite	100.0	22.87	2.18	1.86		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	70.8	7.78	0.64	0.20	88.1	69.2
Sink at 1.60	29.2	61.9	6.24	6.18		
Composite	100.0	23.58	2.28	1.95		

TABLE A-29

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER FREEPORT SEAM, ARMSTRONG COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1771

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.88	12.8	32.8	54.40	2.54	--	1.89	0.65	13,340

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.5	6.46	0.94	0.36	81.0	63.0
Sink at 1.60	15.5	46.8	10.7	10.3		
Composite	100.0	12.71	2.45	1.90		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.1	5.85	0.76	0.18	90.5	70.1
Sink at 1.60	15.9	46.0	10.74	10.6		
Composite	100.0	12.23	2.35	1.84		

TABLE A-30

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER FREEPORT SEAM, ARMSTRONG COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1772

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.14	22.6	30.1	47.30	2.43	--	1.93	0.50	11,675

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	73.2	7.32	0.79	0.23	88.1	67.5
Sink at 1.60	26.8	62.8	7.05	7.05		
Composite	100.0	22.19	2.47	2.06		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	74.1	6.74	0.72	0.16	91.7	70.4
Sink at 1.60	25.9	61.4	6.56	6.57		
Composite	100.0	20.90	2.23	1.82		

TABLE A-31

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification DOUBLE FREEPORT SEAM, ARMSTRONG COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1773

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.99	27.2	28.0	44.80	1.69	0.12	1.11	0.46	10,794

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	64.4	7.64	0.90	0.24	78.4	46.7
Sink at 1.60	35.6	66.0	2.98	2.50		
Composite	100.0	28.42	1.64	1.04		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	63.5	7.18	0.81	0.18	83.8	52.1
Sink at 1.60	36.5	61.7	3.04	2.56		
Composite	100.0	27.08	1.62	1.05		

TABLE A-32

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, SULLIVAN COUNTY, INDIANA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

E. R Lot No. 1774

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
6.07	19.2	39.0	41.80	5.57	0.09	3.94	1.54	11,651

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.5	7.74	2.80	1.07	72.8	49.7
Sink at 1.60	20.5	60.6	15.8	14.8		
Composite	100.0	18.58	5.47	3.88		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.3	7.19	2.42	0.71	82.0	56.6
Sink at 1.60	22.7	54.3	14.6	13.5		
Composite	100.0	17.88	5.18	3.61		

TABLE A-33

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, LAWRENCE COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1775

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
4.82	14.2	43.4	42.40	4.63	0.16	3.93	0.54	12,125

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	82.4	5.94	1.61	0.92	76.6	65.2
Sink at 1.60	17.6	52.9	21.2	20.5		
Composite	100.0	14.20	5.06	4.37		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.6	5.54	1.38	0.70	82.2	70.2
Sink at 1.60	20.4	50.0	17.6	16.9		
Composite	100.0	14.61	4.69	4.00		

TABLE A-34

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 2 SEAM, PEORIA COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1788

Chemical Analysis, As Received:

				Weight %, Dry Basis				
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
8.01	12.4	44.0	43.60	5.93	0.10	4.10	1.73	12,542

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.4	4.54	2.88	1.01	75.4	51.4
Sink at 1.60	15.6	59.0	25.0	24.0		
Composite	100.0	13.04	6.33	4.60		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.4	4.18	2.59	0.71	82.7	56.3
Sink at 1.60	18.6	44.9	16.0	14.7		
Composite	100.0	11.75	5.08	3.31		

TABLE A-35

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, KNOX COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1789

Chemical Analysis, As Received:

		Weight %, Dry Basis						
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
11.4	19.2	38.2	42.60	7.28	0.22	5.60	1.46	11,152

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.5	6.50	3.28	1.47	73.7	54.9
Sink at 1.60	22.5	60.6	23.2	22.1		
Composite	100.0	18.67	7.76	6.11		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	71.9	6.45	2.96	1.08	80.7	59.3
Sink at 1.60	28.1	51.8	18.0	16.6		
Composite	100.0	19.19	7.19	5.44		

TABLE A-36

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, FULTON COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0.

BCR Lot No. 1790

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
10.8	20.0	38.2	41.80	3.98	0.07	2.30	1.61	11,129

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.6	8.74	2.79	0.80	65.2	29.9
Sink at 1.60	22.4	60.2	7.32	6.30		
Composite	100.0	20.27	3.80	2.03		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	76.1	8.66	2.48	0.54	76.5	37.7
Sink at 1.60	23.9	56.4	7.17	6.11		
Composite	100.0	20.07	3.60	1.87		

TABLE A-37

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, MONTGOMERY COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1791

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
10.8	17.1	37.8	45.10	5.00	0.07	3.03	1.90	11,528

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.2	7.01	3.05	0.85	71.9	39.0
Sink at 1.60	20.8	55.9	13.5	12.2		
Composite	100.0	17.18	5.22	3.21		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	78.1	6.65	2.75	0.54	82.2	45.0
Sink at 1.60	21.9	50.6	11.2	9.80		
Composite	100.0	16.28	4.60	2.57		

TABLE A-38

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, JEFFERSON COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1792

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
7.06	19.6	33.6	46.8	1.35	0.03	0.84	0.48	11,233

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.8	6.48	1.07	0.41	51.2	20.7
Sink at 1.60	19.2	72.1	2.80	2.73		
Composite	100.0	19.08	1.40	0.86		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.1	6.72	0.96	0.33	60.7	28.9
Sink at 1.60	20.9	61.6	2.51	2.15		
Composite	100.0	18.19	1.28	0.71		

TABLE A-39

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, PERRY COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1793

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
6.44	15.6	38.3	46.10	4.52	0.07	2.57	1.88	12,086

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.2	7.68	2.84	0.83	67.7	37.2
Sink at 1.60	16.8	56.2	11.9	10.7		
Composite	100.0	15.83	4.36	2.49		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.6	7.11	2.62	0.57	77.8	42.0
Sink at 1.60	19.4	49.2	10.8	9.33		
Composite	100.0	15.28	4.21	2.27		

TABLE A-40

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, JEFFERSON COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1794

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.12	19.6	31.6	48.80	2.34	0.06	1.68	0.60	11,494

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.1	7.00	1.42	0.63	62.5	39.3
Sink at 1.60	20.9	68.3	5.60	5.18		
Composite	100.0	19.81	2.29	1.58		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	76.6	7.00	1.18	0.44	73.8	49.6
Sink at 1.60	23.4	59.6	5.59	5.15		
Composite	100.0	19.31	2.21	1.54		

TABLE A-41

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, FRANKLIN COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1795

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.30	13.2	35.5	51.30	3.02	0.06	1.92	1.04	12,109

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.7	6.18	1.82	0.49	74.5	39.7
Sink at 1.60	14.3	52.2	13.6	12.7		
Composite	100.0	12.76	3.50	2.24		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.1	5.92	1.68	0.37	80.7	44.4
Sink at 1.60	15.9	47.6	11.4	10.4		
Composite	100.0	12.55	3.23	1.96		

TABLE A-42

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, WILLIAMSON COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1796

Chemical Analysis, As Received:

				Weight %, Dry Basis				
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.92	19.6	34.5	45.90	4.38	0.21	2.82	1.35	11,146

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.2	7.66	2.31	0.62	78.0	47.3
Sink at 1.60	22.8	62.5	12.8	11.6		
Composite	100.0	20.16	4.70	3.12		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	75.6	7.23	2.10	0.45	84.0	52.1
Sink at 1.60	24.4	56.6	11.2	9.94		
Composite	100.0	19.28	4.32	2.76		

TABLE A-43

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, FRANKLIN COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1797

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.13	16.0	33.2	50.80	1.14	0.01	0.69	0.44	12,032

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.2	6.28	0.88	0.33	52.2	22.8
Sink at 1.60	15.8	66.2	3.10	2.83		
Composite	100.0	15.75	1.23	0.73		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.2	6.27	0.82	0.25	63.8	28.1
Sink at 1.60	22.8	53.3	2.39	2.04		
Composite	100.0	16.99	1.18	0.66		

TABLE A-44

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 2 SEAM, FULTON COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1798

Chemical Analysis, As Received:

Weight %, Dry Basis								
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.98	21.7	36.2	42.10	5.35	0.53	3.90	0.92	10,880

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	73.7	5.76	2.69	1.19	69.5	49.7
Sink at 1.60	26.3	61.6	12.0	10.8		
Composite	100.0	20.45	5.14	3.72		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	71.5	5.46	2.34	1.02	73.8	56.3
Sink at 1.60	28.5	58.4	12.2	11.2		
Composite	100.0	20.55	5.15	3.92		

TABLE A-45

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, SALINE COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1817

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.72	16.2	33.5	50.30	2.68	0.11	1.80	0.77	12,131

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.8	7.20	1.79	0.84	53.3	33.2
Sink at 1.60	15.2	63.8	7.26	6.51		
Composite	100.0	15.80	2.62	1.70		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.4	6.40	1.45	0.69	61.7	45.9
Sink at 1.60	20.6	49.4	6.34	5.69		
Composite	100.0	15.26	2.46	1.72		

TABLE A-46

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, SALINE COUNTY, ILLINOIS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1818

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.62	20.5	33.6	45.90	5.05	0.18	3.54	1.33	11,312

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	75.2	7.20	2.37	0.82	76.8	53.1
Sink at 1.60	24.8	60.5	13.2	12.0		
Composite	100.0	20.42	5.06	3.59		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	72.3	6.34	2.02	0.53	85.0	60.0
Sink at 1.60	27.7	57.0	12.6	11.5		
Composite	100.0	20.37	4.95	3.57		

TABLE A-47

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, HOPKINS COUNTY, KENTUCKY
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1819

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.84	18.9	33.6	47.50	2.46	0.09	1.84	0.53	11,544

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	75.3	3.28	1.38	0.56	69.6	43.9
Sink at 1.60	24.7	68.8	6.26	5.84		
Composite	100.0	19.46	2.59	1.86		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	74.2	3.78	1.17	0.44	76.1	52.4
Sink at 1.60	25.8	59.0	5.77	5.35		
Composite	100.0	18.03	2.36	1.71		

TABLE A-48

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1820

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.50	10.9	37.0	52.10	2.19	0.08	1.76	0.35	13,168

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.4	4.50	0.51	0.11	93.7	76.7
Sink at 1.60	13.6	56.5	15.1	14.6		
Composite	100.0	11.57	2.49	2.08		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.9	4.18	0.50	0.11	93.7	77.2
Sink at 1.60	16.1	45.6	10.7	10.3		
Composite	100.0	10.85	2.14	1.75		

TABLE A-49

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 7-A SEAM, JEFFERSON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1821

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.27	8.52	38.1	53.37	1.43	0.06	0.98	0.39	13,658

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	89.8	4.66	0.60	0.14	85.7	58.0
Sink at 1.60	10.2	45.6	8.34	7.83		
Composite	100.0	8.84	1.39	0.92		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.4	3.88	0.54	0.09	90.8	62.2
Sink at 1.60	12.6	42.4	9.74	9.20		
Composite	100.0	8.73	1.70	1.24		

TABLE A-50

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, TUSCARAWAS COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1822

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.48	15.8	39.7	44.50	5.81	0.12	4.25	1.44	12,174

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.7	5.30	2.46	0.75	82.4	57.7
Sink at 1.60	18.3	59.6	19.9	18.7		
Composite	100.0	15.24	5.65	4.03		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	78.2	4.76	2.25	0.53	87.5	61.3
Sink at 1.60	21.8	55.6	19.6	18.4		
Composite	100.0	15.84	6.03	4.43		

TABLE A-51

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, TUSCARAWAS COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1823

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
3.48	11.8	40.8	47.40	4.85	0.15	3.23	1.47	12,643

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.9	4.84	2.47	0.76	76.5	49.1
Sink at 1.60	14.1	51.2	17.2	15.9		
Composite	100.0	11.38	4.55	2.89		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	82.0	4.60	2.38	0.69	79.6	50.9
Sink at 1.60	18.0	45.4	16.2	14.9		
Composite	100.0	11.94	4.87	3.25		

TABLE A-52

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1824

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.36	16.5	27.8	55.70	4.00	0.08	3.18	0.74	12,804

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.3	5.61	1.36	0.50	84.3	66.0
Sink at 1.60	22.7	54.2	13.0	12.4		
Composite	100.0	16.64	4.00	3.20		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	76.0	5.16	1.22	0.31	90.3	69.5
Sink at 1.60	24.0	51.4	13.0	12.4		
Composite	100.0	16.26	4.05	3.21		

TABLE A-53

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification KITTANNING SEAM, ARMSTRONG COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1825

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.50	14.8	34.0	51.20	4.83	0.08	4.00	0.75	12,872

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.7	5.84	2.26	1.42	64.5	53.2
Sink at 1.60	18.3	54.7	14.8	14.2		
Composite	100.0	14.78	4.55	3.75		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.3	4.95	1.74	0.90	77.5	64.0
Sink at 1.60	20.7	52.0	16.2	15.5		
Composite	100.0	14.69	4.73	3.92		

TABLE A-54

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER FREEPORT SEAM, CLEARFIELD COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1826

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.39	10.4	25.3	64.30	2.68	0.11	2.01	0.56	13,876

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.6	5.06	0.88	0.31	84.6	67.2
Sink at 1.60	13.4	45.0	11.6	11.1		
Composite	100.0	10.41	2.32	1.76		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.6	4.24	0.70	0.10	95.0	73.9
Sink at 1.60	15.4	39.3	11.0	10.5		
Composite	100.0	9.64	2.29	1.70		

TABLE A-55

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER FREEPORT SEAM, INDIANA COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1827

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.38	18.9	24.6	56.50.	2.16	0.03	1.77	0.36	12,393

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis		
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	77.6	6.96	0.78	0.21
Sink at 1.60	22.4	61.8	6.95	6.65
Composite	100.0	19.24	2.16	1.65

Weight, % Reduction	
Pyritic Sulfur	Total Sulfur
88.1	63.9

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis		
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	77.2	6.05	0.66	0.14
Sink at 1.60	22.8	58.2	6.65	6.33
Composite	100.0	17.94	2.03	1.55

Weight, % Reduction	
Pyritic Sulfur	Total Sulfur
92.1	69.4

TABLE A-56

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification **UPPER FREEPORT SEAM, ARMSTRONG COUNTY, PENNSYLVANIA**
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1828

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.76	16.1	23.8	60.10	2.93	0.06	2.20	0.67	12,546

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.1	7.08	1.24	0.46	79.1	57.7
Sink at 1.60	18.9	57.8	10.5	9.91		
Composite	100.0	16.67	2.99	2.25		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.3	6.56	1.09	0.31	85.9	62.8
Sink at 1.60	22.7	51.4	8.78	8.16		
Composite	100.0	16.74	2.84	2.09		

TABLE A-57

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, ARMSTRONG COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1829

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.91	21.3	33.5	45.20	3.70	0.08	3.10	0.52	11,780

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	72.0	7.39	1.33	0.64	79.4	64.1
Sink at 1.60	28.0	55.6	10.2	9.52		
Composite	100.0	20.89	3.81	3.13		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	69.6	6.95	1.15	0.42	86.5	68.1
Sink at 1.60	30.4	52.3	8.83	8.24		
Composite	100.0	20.74	3.48	2.80		

TABLE A-58

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER FREEPORT SEAM, ARMSTRONG COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1830

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.84	11.6	34.0	54.40	2.25	0.12	1.64	0.49	13,426

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.4	5.72	0.80	0.23	86.0	64.4
Sink at 1.60	14.6	54.3	12.0	11.2		
Composite	100.0	12.87	2.44	1.83		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.7	5.05	0.80	0.16	90.2	64.4
Sink at 1.60	16.3	47.0	9.75	8.97		
Composite	100.0	11.89	2.26	1.60		

TABLE A-59

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER CLARION SEAM, CLARION COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1831

Chemical Analysis, As Received:

				Weight %, Dry Basis				
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.44	15.2	34.0	50.80	2.54	0.07	1.92	0.55	12,530

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.8	5.80	1.05	0.34	82.3	58.7
Sink at 1.60	18.2	57.9	8.75	8.18		
Composite	100.0	15.28	2.45	1.77		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.1	5.60	1.05	0.34	82.3	58.7
Sink at 1.60	19.9	51.0	7.92	7.32		
Composite	100.0	14.63	2.42	1.73		

TABLE A-60

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 4-A SEAM, JACKSON COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1832

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
3.12	9.95	42.2	47.85	3.88	0.19	1.93	1.76	12,574

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	86.4	3.75	2.57	0.60	68.9	33.8
Sink at 1.60	13.6	50.4	12.0	10.1		
Composite	100.0	10.09	3.85	1.89		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.3	4.07	2.38	0.44	77.2	38.7
Sink at 1.60	15.7	40.6	10.5	8.55		
Composite	100.0	9.81	3.65	1.71		

TABLE A-63

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 5 SEAM, MUSKINGUM COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1835

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.64	12.0	39.9	48.10	5.36	0.36	4.62	0.38	12,334

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.3	4.56	1.24	0.44	90.5	76.9
Sink at 1.60	14.7	51.2	24.2	22.4		
Composite	100.0	11.42	4.62	3.67		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.9	4.31	1.16	0.41	91.1	78.4
Sink at 1.60	18.1	42.9	22.2	20.9		
Composite	100.0	11.29	4.97	4.12		

TABLE A-62

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER FREEPORT SEAM, CLEARFIELD COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1834

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.51	12.8	27.0	60.20	3.48	0.10	2.86	0.52	13,508

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.5	7.38	1.14	0.61	78.7	67.2
Sink at 1.60	15.5	47.6	15.7	15.0		
Composite	100.0	13.61	3.40	2.84		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.7	5.96	0.88	0.33	88.5	74.7
Sink at 1.60	18.3	45.6	13.9	13.4		
Composite	100.0	13.21	3.26	2.72		

TABLE A-61

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 7-A SEAM, GUERNSEY COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1833

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.84	27.0	34.6	38.40	3.89	0.09	2.62	1.18	10,263

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	68.6	6.37	2.97	1.22	53.4	23.7
Sink at 1.60	31.4	69.5	6.36	5.39		
Composite	100.0	26.19	4.03	2.53		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	65.0	6.99	2.56	0.95	63.7	34.2
Sink at 1.60	35.0	61.8	6.12	5.20		
Composite	100.0	26.17	3.81	2.44		

TABLE A-64

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER KITTANNING SEAM, CAMBRIA COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1836

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.51	33.0	14.3	52.70	1.17	0.04	1.00	0.13	10,075

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	55.9	7.96	0.60	0.16	84.0	48.7
Sink at 1.60	44.1	69.4	1.96	1.71		
Composite	100.0	35.06	1.20	0.84		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	52.9	7.62	0.57	0.18	82.0	51.3
Sink at 1.60	47.1	65.8	1.90	1.65		
Composite	100.0	35.02	1.20	0.87		

TABLE A-65

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification **UPPER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA**
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1837

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.51	16.0	26.8	57.20	3.94	0.14	3.19	0.61	12,827

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.8	6.90	1.34	0.60	81.2	66.0
Sink at 1.60	20.2	55.7	13.4	12.4		
Composite	100.0	16.76	3.78	2.98		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	76.9	5.50	0.91	0.22	93.1	76.9
Sink at 1.60	23.1	52.4	13.2	12.3		
Composite	100.00	16.33	3.75	3.01		

TABLE A-66

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification NO. 6 SEAM, MUSKINGUM COUNTY, OHIO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1838

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.39	6.52	44.6	48.90	3.10	0.09	1.55	1.46	13,222

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	92.1	3.72	1.98	0.37	76.1	36.1
Sink at 1.60	7.9	39.0	13.4	11.2		
Composite	100.0	6.51	2.88	1.23		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.1	3.23	1.90	0.28	81.9	38.7
Sink at 1.60	11.9	28.6	10.9	9.04		
Composite	100.0	6.25	2.97	1.32		

TABLE A-67

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification MIDDLE KITTANNING SEAM,
CLEARFIELD COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1839

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.42	21.4	25.0	53.60	9.24	0.12	8.45	0.67	11,812

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	67.7	10.4	4.16	3.23	61.8	55.0
Sink at 1.60	32.3	45.6	18.2	17.4		
Composite	100.0	21.77	8.69	7.81		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	66.3	8.24	3.04	2.06	75.6	67.1
Sink at 1.60	33.7	48.4	20.2	19.4		
Composite	100.0	21.77	8.82	7.90		

TABLE A-68

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1840

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.58	12.6	28.6	58.80	3.54	0.20	2.63	0.71	13,434

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.1	4.90	1.30	0.49	81.4	63.3
Sink at 1.60	19.9	46.8	12.2	11.2		
Composite	100.0	13.24	3.47	2.62		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.7	4.18	1.06	0.28	89.4	70.1
Sink at 1.60	20.3	46.6	13.2	12.3		
Composite	100.0	12.79	3.52	2.72		

TABLE A-69

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification MIDDLE KITTANNING SEAM, CLARION COUNTY, PA.
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1841

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.26	7.64	36.6	55.76	0.68	0.02	0.22	0.44	13,343

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	91.0	4.61	0.56	0.09	59.1	17.6
Sink at 1.60	9.0	38.2	1.09	0.69		
Composite	100.0	7.63	0.61	0.14		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.9	4.44	0.56	0.10	54.5	17.6
Sink at 1.60	12.1	32.0	1.38	0.98		
Composite	100.0	7.77	0.66	0.21		

TABLE A-70

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER CLARION SEAM, CLARION COUNTY, PENNSYLVANIA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1842

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.73	16.2	38.6	45.20	9.12	0.18	7.67	1.27	13,411

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	73.2	6.52	3.42	2.01	73.8	62.5
Sink at 1.60	26.8	48.9	24.0	21.1		
Composite	100.0	17.88	8.94	7.13		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	70.4	5.63	3.05	1.57	79.5	66.6
Sink at 1.60	29.6	44.8	24.0	21.5		
Composite	100.0	17.22	9.25	7.46		

TABLE B-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER FREEPORT SEAM, ARMSTRONG COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

BCR Sample No. 1866

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	37.6		0.47	7.18	1.08	
Zone B	33.0		0.42	7.42	1.15	
Zone C						
Float at 1.60	7.2	95.5	0.50	9.24	1.46	
Sink at 1.60	0.3	4.5	0.52	47.7	7.32	
Composite	7.5	100.0	0.50	10.97	1.72	
Zone D						
Float at 1.60	4.1	20.9	0.44	17.4	2.07	
Float at 2.95	14.7	75.9	0.95	70.7	3.54	
Sink at 2.95	0.6	3.2	0.38	66.0	32.6	13.6
Composite	19.4	100.0	0.83	59.41	4.16	
Zone E						
Float at 2.95	1.5	60.6	0.27	85.9	4.42	5.73
Sink at 2.95	1.0	39.4	0.38	64.0	38.8	14.8
Composite	2.5	100.0	0.31	77.27	17.97	9.30
Composite of Zones A, B, C	78.1		0.45	7.65	1.17	
Composite of 1.60 Float Fractions	81.9		0.45	7.97	1.19	
Composite of 2.95 Sink Fractions	1.6		0.38	64.75	36.48	14.35
Composite of Table Products	100.0		0.52	19.43	2.17	
Analysis of Feed to Table			1.13	18.9	2.02	

Run Date: 5-14-68

TABLE B-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER FREEPORT SEAM, ARMSTRONG COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0

BCR Sample No. 1866

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	71.5		0.75	12.0	1.00	
Zone B	11.2		0.43	11.0	0.94	
Zone C						
Float at 1.60	1.8	93.7	0.24	15.4	1.22	
Sink at 1.60	0.1	6.3	0.20	21.8	5.29	
Composite	1.9	100.0	0.24	15.80	1.48	
Zone D						
Float at 1.60	1.5	11.7	0.61	26.2	1.77	
Float at 2.95	11.1	83.7	1.41	71.7	2.22	
Sink at 2.95	0.6	4.6	0.29	65.8	32.0	15.8
Composite	13.2	100.0	1.26	66.11	3.54	
Zone E						
Float at 2.95	0.2	8.6	1.30	87.5	4.75	5.13
Sink at 2.95	2.0	91.4	0.16	63.6	41.4	16.2
Composite	2.2	100.0	0.26	65.66	38.25	15.25
Composite of Zones A, B, C	84.6		0.70	11.96	1.00	
Composite of 1.60 Float Fractions	86.0		0.70	12.20	1.01	
Composite of 2.95 Sink Fractions	2.6		0.19	64.11	39.23	16.11
Composite of Table Products	100.0		0.76	20.28	2.16	
Analysis of Feed to Table			1.08	19.6	2.12	

Run Date: 5-13-68

TABLE B-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	43.7		1.68	6.09	1.43	
Zone B	38.6		1.12	6.32	1.74	
Zone C						
Float at 1.60	5.6	94.4	0.47	7.90	2.48	
Sink at 1.60	0.3	5.6	0.24	45.2	16.6	
Composite	5.9	100.0	0.45	9.99	3.27	
Zone D						
Float at 1.60	2.1	19.0	0.11	18.5	5.72	
Float at 2.95	8.1	72.5	0.34	74.2	5.18	
Sink at 2.95	1.0	8.5	0.24	61.8	41.4	4.8
Composite	11.2	100.0	0.29	62.56	8.36	
Zone E						
Float at 2.95	0.2	38.0	0.98	83.1	4.14	5.5
Sink at 2.95	0.4	62.0	0.15	63.8	37.9	5.7
Composite	0.6	100.0	0.47	71.13	25.07	5.62
Composite of Zones A, B, C	88.2		1.35	6.45	1.69	
Composite of 1.60 Float Fractions	90.0		1.33	6.59	1.73	
Composite of 2.95 Sink Fractions	1.4		0.21	62.37	40.40	5.06
Composite of Table Products	100.0		1.22	13.12	2.58	
Analysis of Feed to Table			2.98	13.4	2.71	

Run Date: 5-28-68

TABLE B-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	77.0		1.20	8.01	1.57	
Zone B	14.5		1.32	6.72	1.42	
Zone C	0.48	95.6	0.55	9.27	1.90	
Float at 1.60	0.02	4.4	0.52	38.0	9.95	
Sink at 1.60	0.5	100.0	0.57	10.53	2.25	
Composite						
Zone D						
Float at 1.60	2.6	38.1	0.74	17.7	4.29	
Float at 2.95	3.9	57.0	0.70	67.4	7.28	
Sink at 2.95	0.3	4.9	0.52	63.3	41.8	6.3
Composite	6.8	100.0	0.71	48.26	7.83	
Zone E						
Float at 2.95	0.1	9.9	0.88	74.0	7.42	8.0
Sink at 2.95	1.1	90.1	0.76	64.0	43.7	5.0
Composite	1.2	100.0	0.77	64.99	40.11	5.30
Composite of Zones A, B, C	92.0		1.22	7.82	1.55	
Composite of 1.60 Float Fractions	94.6		1.20	8.09	1.62	
Composite of 2.95 Sink Fractions	1.4		0.71	63.85	43.29	5.28
Composite of Table Products	100.0		1.18	11.26	2.44	
Analysis of Feed to Table			2.92	13.0	2.84	

Run Date: 6-5-68

TABLE B-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	47.9		1.17	6.12	1.72	
Zone B	37.3		1.46	6.36	1.98	
Zone C						
Float at 1.60	5.2	79.0	1.21	11.8	4.02	
Sink at 1.60	1.4	21.0	0.36	39.5	12.3	
Composite	6.6	100.0	1.03	17.62	5.76	
Zone D						
Float at 1.60	0.4	4.6	0.60	18.1	4.88	
Float at 2.95	6.7	84.9	1.43	74.2	6.48	
Sink at 2.95	0.8	10.5	0.38	62.2	39.2	9.5
Composite	7.9	100.0	1.28	70.36	9.84	
Zone E						
Float at 2.95	0.1	24.7	1.56	84.2	5.09	4.8
Sink at 2.95	0.2	75.3	0.33	64.9	41.8	4.6
Composite	0.3	100.0	0.63	69.67	32.73	4.65
Composite of Zones A, B, C	91.8		1.28	7.05	2.12	
Composite of 1.60 Float Fractions	90.8		1.29	6.59	1.97	
Composite of 2.95 Sink Fractions	1.0		0.37	62.74	39.72	8.52
Composite of Table Products	100.0		1.28	12.23	2.82	
Analysis of Feed to Table			2.64	12.0	2.90	

Run Date: 6-4-68

TABLE B-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (6/4/68) Crushed to 30 Mesh x 0

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	82.2		0.00	5.20	1.39	
Zone B	12.8		1.00	6.03	1.40	
Zone C						
Float at 1.60	0.39	96.7	0.86	9.21	2.02	
Sink at 1.60	0.01	3.3	0.50	50.8	19.3	
Composite	0.4	100.0	0.85	10.58	2.59	
Zone D						
Float at 1.60	2.0	48.6	0.61	17.7	4.09	
Float at 2.95	1.9	45.4	0.60	54.0	11.4	
Sink at 2.95	0.2	6.0	0.18	63.2	40.7	6.4
Composite	4.1	100.0	0.58	36.91	9.61	
Zone E						
Float at 2.95	0.02	4.3	0.70	64.5	19.4	13.8
Sink at 2.95	0.48	95.7	0.14	63.7	40.2	5.6
Composite	0.5	100.0	0.16	63.73	39.31	5.95
Composite of Zones A, B, C	95.4		0.14	5.33	1.40	
Composite of 1.60 Float Fractions	97.4		0.15	5.59	1.45	
Composite of 2.95 Sink Fractions	0.68		0.15	63.56	40.34	5.83
Composite of Table Products	100.0		0.16	6.92	1.92	
Analysis of Feed to Table			2.67	6.52	2.04	

Run Date: 6-13-68

TABLE B-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Composite of 3/8 Inch x 0 Run (6/4/68) and 30 Mesh x 0 Run (6/13/68)

BCR Sample No. 1950

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	75.4		0.00	5.20	1.39	
Zone B	11.7		1.00	6.03	1.40	
Zone C	0.39	96.7	0.86	9.21	2.02	
Float at 1.60	0.01	3.3	0.50	50.8	19.3	
Sink at 1.60	0.4	100.0	0.85	10.58	2.59	
Composite						
Zone D						
Float at 1.60	2.3	19.7	0.61	17.77	4.23	
Float at 2.95	8.4	71.8	1.25	69.91	7.52	
Sink at 2.95	1.0	8.5	0.34	62.40	39.50	8.9
Composite	11.7	100.0	1.05	59.00	9.59	
Zone E						
Float at 2.95	0.12	15.0	1.42	80.91	7.48	6.3
Sink at 2.95	0.68	85.0	0.20	64.05	40.67	5.3
Composite	0.8	100.0	0.38	66.58	35.69	5.45
Composite of Zones A, B, C	87.5		0.14	5.33	1.40	
Composite of 1.60 Float Fractions	89.8		0.15	5.65	1.47	
Composite of 2.95 Sink Fractions	1.7		0.28	63.07	39.97	7.42
Composite of Table Products	100.0		0.25	12.10	2.63	
Analysis of Feed to Table			2.64	12.0	2.90	

TABLE B-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

BCR Sample No. 2012

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	56.9		0.58	6.74	1.50	
Zone B	22.9		0.42	5.96	1.51	
Zone C						
Float at 1.60	3.0	57.9	0.51	14.3	3.66	
Sink at 1.60	2.1	42.1	0.39	45.9	8.68	
Composite	5.1	100.0	0.46	27.60	5.77	
Zone D						
Float at 1.60	0.2	1.5	0.62	16.3	3.80	
Float at 2.95	11.3	88.8	0.93	76.2	5.81	
Sink at 2.95	1.2	9.7	0.22	62.4	36.5	10.8
Composite	12.7	100.0	0.86	68.66	8.76	
Zone E						
Float at 2.95	0.8	32.1	0.44	79.4	9.19	7.3
Sink at 2.95	1.6	67.9	0.05	62.5	40.5	8.7
Composite	2.4	100.0	0.18	67.92	30.45	8.25
Composite of Zones A, B, C	84.9		0.53	7.78	1.76	
Composite of 1.60 Float Fractions	83.0		0.53	6.82	1.59	
Composite of 2.95 Sink Fractions	2.8		0.12	62.46	38.78	9.60
Composite of Table Products	100.0		0.56	16.96	3.34	
Analysis of Feed to Table			1.22	20.7	3.43	

Run Date: 6-25-68

TABLE B-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Zones A, B, C, 3/8 Inch x 0 Run (6/25/68) Crushed to 30 Mesh x 0

BCR Sample No. 2012

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	80.7		0.36	4.96	1.06	
Zone B	14.2		0.48	5.68	1.07	
Zone C						
Float at 1.60	0.87	96.5	0.52	8.96	1.73	
Sink at 1.60	0.03	3.5	0.56	37.1	10.6	
Composite	0.9	100.0	0.52	9.94	2.04	
Zone D						
Float at 1.60	1.9	52.0	0.44	20.1	2.79	
Float at 2.95	1.7	46.6	0.37	50.1	9.64	
Sink at 2.95	0.1	1.4	0.22	59.4	39.3	
Composite	3.7	100.0	0.40	34.6	6.49	
Zone E						
Float at 2.95	0.1	10.1	0.30	57.0	26.0	
Sink at 2.95	0.4	89.9	0.28	60.6	42.0	
Composite	0.5	100.0	0.28	60.2	40.38	
Composite of Zones A, B, C	95.8		0.38	5.12	1.07	
Composite of 1.60 Float Fractions	97.7		0.38	5.40	1.10	
Composite of 2.95 Sink Fractions	0.5		0.27	60.36	41.46	
Composite of Table Products	100.0		0.38	6.48	1.47	
Analysis of Feed to Table			1.15	6.94	1.65	

Run Date: 7-2-68

TABLE B-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Composite of 3/8 x 0 Run (6/25/68) and 30 Mesh x 0 Run (7/2/68)

BCR Sample No. 2012

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	68.5		0.36	4.96	1.06	
Zone B	12.1		0.48	5.68	1.07	
Zone C						
Float at 1.60	0.77	96.5	0.52	8.96	1.73	
Sink at 1.60	0.03	3.5	0.56	37.1	10.6	
Composite	0.8	100.0	0.52	9.94	2.04	
Zone D						
Float at 1.60	1.8	11.4	0.46	19.68	2.90	
Float at 2.95	12.7	80.4	0.87	73.32	6.23	
Sink at 2.95	1.3	8.2	0.22	62.17	36.72	
Composite	15.8	100.0	0.77	66.29	8.35	
Zone E						
Float at 2.95	0.9	32.1	0.42	76.91	11.06	
Sink at 2.95	1.9	67.9	0.09	62.20	40.74	
Composite	2.8	100.0	0.20	66.92	31.21	
Composite of Zones A, B, C	81.4		0.38	5.12	1.07	
Composite of 1.60 Float Fractions	83.2		0.38	5.43	1.11	
Composite of 2.95 Sink Fractions	3.2		0.14	62.19	39.11	
Composite of Table Products	100.0		0.44	16.51	3.07	
Analysis of Feed to Table			1.22	20.7	3.43	

TABLE B-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

BCR Sample No. 2013

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	39.6		0.43	7.84	3.11	
Zone B	45.1		0.22	8.18	3.13	
Zone C						
Float at 1.60	4.6	59.6	0.48	11.2	3.82	
Sink at 1.60	3.1	40.4	0.51	46.8	7.19	
Composite	7.7	100.0	0.49	25.58	5.18	
Zone D						
Float at 1.60	0.2	2.4	0.74	13.8	4.12	
Float at 2.95	6.3	84.9	1.28	74.0	5.65	
Sink at 2.95	0.9	12.7	0.44	57.0	38.2	17.5
Composite	7.4	100.0	1.16	70.40	9.75	
Zone E						
Float at 2.95	0.06	29.2	1.16	78.8	8.62	8.5
Sink at 2.95	0.14	70.8	0.26	60.6	41.7	9.0
Composite	0.2	100.0	0.52	65.91	32.04	8.85
Composite of Zones A, B, C	92.4		0.33	9.48	3.29	
Composite of 1.60 Float Fractions	89.5		0.33	8.19	3.16	
Composite of 2.95 Sink Fractions	1.04		0.42	57.49	38.67	16.35
Composite of Table Products	100.0		0.39	14.10	3.83	
Analysis of Feed to Table			3.00	15.6	3.78	

Run Date: 6-28-68

TABLE B-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (6/28/68) Crushed to 30 Mesh x 0

BCR Sample No. 2013

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	78.0		0.70	7.82	2.70	
Zone B	14.5		0.16	7.71	2.74	
Zone C						
Float at 1.60	2.0	96.8	0.28	10.1	3.27	
Sink at 1.60	0.1	3.2	1.02	39.0	4.74	
Composite	2.1	100.0	0.30	11.02	3.32	
Zone D						
Float at 1.60	2.9	57.4	0.39	18.2	4.57	
Float at 2.95	2.1	41.3	0.38	45.6	8.16	
Sink at 2.95	0.1	1.3	0.38	60.8	43.7	7.0
Composite	5.1	100.0	0.39	30.07	6.56	
Zone E						
Float at 2.95	0.1	31.0	1.06	56.6	18.0	23.0
Sink at 2.95	0.2	69.0	0.24	61.6	42.7	8.0
Composite	0.3	100.0	0.49	60.05	35.04	12.65
Composite of Zones A, B, C	94.6		0.61	7.87	2.72	
Composite of 1.60 Float Fractions	97.4		0.60	8.16	2.77	
Composite of 2.95 Sink Fractions	0.3		0.29	61.33	43.03	7.68
Composite of Table Products	100.0		0.60	9.16	3.01	
Analysis of Feed to Table			3.77	9.22	3.04	

Run Date: 7-5-68

TABLE B-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Composite of 3/8 Inch x 0 Run (6/28/68) and 30 Mesh x 0 Run (7/5/68)

BCR Sample No. 2013

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	72.1		0.70	7.82	2.70	
Zone B	13.4		0.16	7.71	2.74	
Zone C						
Float at 1.60	1.8	96.8	0.28	10.1	3.27	
Sink at 1.60	0.1	3.2	1.02	39.0	4.74	
Composite	1.9	100.0	0.30	11.02	3.32	
Zone D						
Float at 1.60	2.9	24.0	0.41	17.90	4.54	
Float at 2.95	8.2	67.8	1.07	67.41	6.23	
Sink at 2.95	1.0	8.2	0.43	57.38	38.75	16.45
Composite	12.1	100.0	0.86	54.71	8.49	
Zone E						
Float at 2.95	0.2	32.0	1.10	64.93	14.48	17.56
Sink at 2.95	0.3	68.0	0.25	61.19	42.29	8.41
Composite	0.5	100.0	0.52	62.39	33.39	11.34
Composite of Zones A, B, C	87.4		0.61	7.87	2.72	
Composite of 1.60 Float Fractions	90.2		0.60	8.17	2.78	
Composite of 2.95 Sink Fractions	1.3		0.39	58.26	39.57	14.59
Composite of Table Products	100.0		0.64	13.8	3.57	
Analysis of Feed to Table			3.00	15.6	3.78	

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TABLE B-14

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2026

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	46.5		1.08	3.86	1.84	
Zone B	36.9		1.10	4.08	2.02	
Zone C						
Float at 1.60	7.9	72.0	0.54	7.41	3.52	
Sink at 1.60	3.1	28.0	0.58	39.3	17.8	
Composite	11.0	100.0	0.55	16.34	7.52	
Zone D						
Float at 1.60	0.1	2.3	1.40	12.1	4.42	
Float at 2.95	1.9	46.8	0.92	55.2	22.4	
Sink at 2.95	2.1	50.9	0.48	60.0	41.8	
Composite	4.1	100.0	0.71	56.65	31.86	
Zone E						
Float at 2.95	0.1	5.5	0.68	52.4	28.3	
Sink at 2.95	1.4	94.5	0.18	62.4	43.8	
Composite	1.5	100.0	0.21	61.85	42.95	
Composite of Zones A, B, C	94.4		1.03	5.39	2.57	
Composite of 1.60 Float Fractions	91.4		1.04	4.26	2.06	
Composite of 2.95 Sink Fractions	3.5		0.36	60.96	42.60	
Composite of Table Products	100.0		1.00	8.35	4.38	
Analysis of Feed to Table			2.82	8.16	4.17	

Run Date: 7-29-68

TABLE B-15

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (7-29-68) Crushed to 30 Mesh x 0

BCR Sample No. 2026

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	79.9		1.72	3.73	1.66	
Zone B	15.5		0.92	3.60	1.53	
Zone C						
Float at 1.60	0.67	96.2	0.93	5.41	2.08	
Sink at 1.60	0.03	3.8	1.00	37.3	18.3	
Composite	0.7	100.0	0.93	6.62	2.70	
Zone D						
Float at 1.60	1.8	57.8	1.28	24.2	5.09	
Float at 2.95	1.1	37.1	1.30	41.6	15.6	
Sink at 2.95	0.2	5.1	0.38	60.6	40.8	
Composite	3.1	100.0	1.24	32.51	10.81	
Zone E						
Float at 2.95	0.1	14.3	0.46	56.9	31.0	
Sink at 2.95	0.7	85.7	0.74	62.6	44.6	
Composite	0.8	100.0	0.70	61.78	42.66	
Composite of Zones A, B, C	96.1		1.59	3.73	1.65	
Composite of 1.60 Float Fractions	97.9		1.58	4.09	1.70	
Composite of 2.95 Sink Fractions	0.9		0.66	62.16	43.76	
Composite of Table Products	100.0		1.57	5.09	2.26	
Analysis of Feed to Table			2.64	5.18	2.52	

Run Date: 7-31-68

TABLE B-16

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Composite of 3/8 Inch x 0 Run (7-29-68) and 30 Mesh x 0 Run (7-31-68)

BCR Sample No. 2026

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	75.4		1.72	3.73	1.66	
Zone B	14.6		0.92	3.60	1.53	
Zone C						
Float at 1.60	0.67	96.2	0.93	5.41	2.08	
Sink at 1.60	0.03	3.8	1.00	37.3	18.3	
Composite	0.7	100.0	0.93	6.62	2.70	
Zone D						
Float at 1.60	1.8	25.7	1.29	23.52	5.05	
Float at 2.95	2.9	41.4	1.05	50.51	20.05	
Sink at 2.95	2.3	32.9	0.47	60.05	41.71	
Composite	7.0	100.0	0.92	46.71	23.32	
Zone E						
Float at 2.95	0.2	8.7	0.57	54.65	29.65	
Sink at 2.95	2.1	91.3	0.37	62.47	44.07	
Composite	2.3	100.0	0.39	61.79	42.82	
Composite of Zones A, B, C	90.7		1.58	3.73	1.65	
Composite of 1.60 Float Fractions	92.5		1.58	4.10	1.71	
Composite of 2.95 Sink Fractions	4.4		0.42	61.20	42.84	
Composite of Table Products	100.0		1.51	8.08	4.11	
Analysis of Feed to Table			2.82	8.16	4.17	

TABLE B-17

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2031

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	61.1		0.18	5.56	1.65	
Zone B	16.7		0.14	6.13	1.85	
Zone C						
Float at 1.60	3.1	55.1	0.22	13.0	3.02	
Sink at 1.60	2.6	44.9	0.26	42.7	9.42	
Composite	5.7	100.0	0.24	26.34	5.89	
Zone D						
Float at 1.60	0.3	2.0	0.28	16.4	3.75	
Float at 2.95	9.9	72.0	0.26	68.8	8.96	
Sink at 2.95	3.6	26.0	0.26	61.6	39.6	
Composite	13.8	100.0	0.26	65.88	16.82	
Zone E						
Float at 2.95	1.0	37.3	0.24	65.0	9.44	
Sink at 2.95	1.7	62.7	0.00	62.8	41.3	
Composite	2.7	100.0	0.09	63.62	29.42	
Composite of Zones A, B, C	83.5		0.18	7.09	1.98	
Composite of 1.60 Float Fractions	81.2		0.17	6.00	1.75	
Composite of 2.95 Sink Fractions	5.3		0.18	61.99	40.15	
Composite of Table Products	100.0		0.19	16.73	4.77	
Analysis of Feed to Table			2.90	15.2	4.42	

Run Date: 7-18-68

TABLE B-18

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Zones A, B, and C, 3/8 Inch x 0 Run (7/18/68) Crushed to 30 Mesh x 0

BCR Sample No. 2031

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	79.1		0.31	5.49	1.54	
Zone B	14.6		0.20	6.16	1.49	
Zone C						
Float at 1.60	0.67	96.2	0.60	8.82	1.76	
Sink at 1.60	0.03	3.8	0.41	38.9	8.00	
Composite	0.7	100.0	0.59	9.96	2.00	
Zone D						
Float at 1.60	2.7	50.9	0.58	18.6	2.45	
Float at 2.95	2.5	47.5	1.19	47.7	7.52	
Sink at 2.95	0.1	1.6	0.39	61.2	39.5	9.5
Composite	5.3	100.0	0.87	33.10	5.45	
Zone E						
Float at 2.95	0.2	74.6	0.52	63.7	19.5	16.5
Sink at 2.95	0.1	25.4	0.40	61.8	42.9	7.5
Composite	0.3	100.0	0.49	63.22	25.44	14.21
Composite of Zones A, B, C	94.4		0.29	5.63	1.54	
Composite of 1.60 Float Fractions	97.1		0.30	5.99	1.56	
Composite of 2.95 Sink Fractions	0.2		0.40	61.50	41.20	8.5
Composite of Table Products	100.0		0.33	7.26	1.81	
Analysis of Feed to Table			2.10	6.90	1.82	

Run Date: 7-24-68

TABLE B-19

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Composite of 3/8 Inch x 0 Run (7/18/68) and 30 Mesh x 0 Run (7/24/68)

BCR Sample No. 2031

			Chemical Analysis, Dry Basis, Weight Percent			
Table Products	Product Weight Percent	Float and Sink Weight Percent	Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	66.0		0.31	5.49	1.54	
Zone B	12.2		0.20	6.16	1.49	
Zone C						
Float at 1.60	0.58	96.2	0.60	8.82	1.76	
Sink at 1.60	0.02	3.8	0.41	38.9	8.00	
Composite	0.6	100.0	0.59	9.96	2.00	
Zone D						
Float at 1.60	2.5	13.7	0.54	18.34	2.61	
Float at 2.95	12.0	66.0	0.42	65.11	8.71	
Sink at 2.95	3.7	20.3	0.26	61.59	39.60	
Composite	18.2	100.0	0.40	57.99	14.14	
Zone E						
Float at 2.95	1.2	40.0	0.29	64.78	11.12	
Sink at 2.95	1.8	60.0	0.02	62.74	41.39	
Composite	3.0	100.0	0.13	63.56	29.28	
Composite of Zones A, B, C	78.8		0.30	5.63	1.54	
Composite of 1.60 Float Fractions	81.3		0.30	6.01	1.57	
Composite of 2.95 Sink Fractions	5.5		0.18	61.97	40.19	
Composite of Table Products	100.0		0.31	16.90	4.66	
Analysis of Feed to Table			2.90	15.2	4.42	

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TABLE C-1

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 1, Run No. 2

Run No. 2

BCR Sample No. 1950

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	2 in.	Flowrate of Pulp, usgpm	22.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.39
Dry Feed, tph	0.5	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	86.8	93.2	6.47	1.16
Sink at 1.60	6.3	6.8	43.9	9.80
Composite	93.1	100.0	9.02	1.75
Underflow				
Float at 1.60	4.3	62.0	8.64	1.89
Sink at 1.60	2.6	38.0	59.0	20.8
Composite	6.9	100.0	27.78	9.08
Composite of Cyclone Products	100.0		10.3	2.26
Analysis of Feed to Cyclone			10.0	2.12

Run Date: 11-1-68

TABLE C-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 1, Run No. 3

Run No. 3 BCR Sample No. 1950

Operating Conditions:

Cone Type	5	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1.25 in.	Flowrate of Pulp, usgpm	22.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.40
Dry Feed, tph	0.5	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	90.5	93.3	7.00	1.22
Sink at 1.60	6.5	6.7	49.3	12.4
Composite	97.0	100.0	9.83	1.97
Underflow				
Float at 1.60	1.2	38.4	7.98	1.76
Sink at 1.60	1.8	61.6	64.0	23.2
Composite	3.0	100.0	42.49	14.97
Composite of Cyclone Products	100.0		10.81	2.36
Analysis of Feed to Cyclone			10.1	2.22

Run Date: 11-1-68

TABLE C-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 1, Run No. 4

Run No. 4 BCR Sample No. 1950

Operating Conditions:

Cone Type	M	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1.25 in.	Flowrate of Pulp, usgpm	22.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.39
Dry Feed, tph	0.5	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	69.4	91.8	6.44	1.08
Sink at 1.60	6.2	8.2	43.1	7.96
Composite	75.6	100.0	9.44	1.64
Underflow				
Float at 1.60	21.2	86.8	6.54	1.36
Sink at 1.60	3.2	13.2	54.8	18.1
Composite	24.4	100.0	12.91	3.57
Composite of Cyclone Products	100.0		10.29	2.11
Analysis of Feed to Cyclone			10.0	2.12

Run Date: 11-1-68

TABLE C-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 2, Run No. 1

Run No. 1

BCR Sample No. 1950

Operating Conditions:

Cone Type M
Vortex Finder Clearance 1.0 in.
Inlet Pressure 8 psi
Dry Feed, tph 1.1

Specific Gravity, Pulp 1.02
Flowrate of Pulp, usgpm 58.2
Specific Gravity, Solids 1.41
Weight Percent, Solids 8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	81.8	93.0	6.88	1.20
Sink at 1.60	6.2	7.0	47.0	9.37
Composite	88.0	100.0	9.69	1.77
Underflow				
Float at 1.60	8.3	69.0	7.03	1.52
Sink at 1.60	3.7	31.0	65.4	17.9
Composite	12.0	100.0	25.12	6.60
Composite of Cyclone Products	100.0		11.54	2.35
Analysis of Feed to Cyclone			11.40	2.42

Run Date: 11-19-68

TABLE C-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 2, Run No. 2

Run No. 2

BCR Sample No. 1950

Operating Conditions:

Cone Type M
Vortex Finder Clearance 1.0 in.
Inlet Pressure 8 psi
Dry Feed, tph 3.7

Specific Gravity, Pulp 1.08
Flowrate of Pulp, usgpm 70.8
Specific Gravity, Solids 1.41
Weight Percent, Solids 25.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Ash	Total Sulfur
Overflow				
Float at 1.60	83.7	91.6	6.20	1.12
Sink at 1.60	7.7	8.4	45.9	11.0
Composite	91.4	100.0	9.53	1.95
Underflow				
Float at 1.60	5.5	64.4	6.36	1.38
Sink at 1.60	3.1	35.6	65.0	19.8
Composite	8.6	100.0	27.24	7.94
Composite of Cyclone Products	100.0		11.05	2.47
Analysis of Feed to Cyclone			11.40	2.42

Run Date: 11-19-68

TABLE C-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 2, Run No. 3

Run No. 3 BCR Sample No. 1950

Operating Conditions:

Cone Type	M	Specific Gravity, Pulp	1.08
Vortex Finder Clearance	1.0 in.	Flowrate of Pulp, usgpm	43.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.41
Dry Feed, tph	2.3	Weight Percent, Solids	25.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	81.7	91.5	6.10	1.15
Sink at 1.60	7.6	8.5	45.1	10.4
Composite	89.3	100.0	9.42	1.94
Underflow				
Float at 1.60	6.7	62.8	6.52	1.34
Sink at 1.60	4.0	37.2	65.9	18.8
Composite	10.7	100.0	28.61	7.84
Composite of Cyclone Products	100.0		11.47	2.57
Analysis of Feed to Cyclone			11.4	2.56

Run Date: 11-19-68

TABLE C-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 3, Run No. 3

Run No. 3 BCR Sample No. 1950

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	2.0 in.	Flowrate of Pulp, usgpm	36.8
Inlet Pressure	6 psi (Calc.)	Specific Gravity, Solids	1.39
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	90.9	93.0	5.80	1.14
Sink at 1.60	6.8	7.0	48.4	10.6
Composite	97.7	100.0	8.78	1.80
Underflow				
Float at 1.60	1.1	46.7	9.26	2.04
Sink at 1.60	1.2	53.3	66.1	18.2
Composite	2.3	100.0	39.56	10.65
Composite of Cyclone Products	100.0		9.49	2.00
Analysis of Feed to Cyclone			10.0	2.22

Run Date: 12-6-68

TABLE C-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 3, Run No. 4

Run No. 4 BCR Sample No. 1950

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	2.5 in.	Flowrate of Pulp, usgpm	36.8
Inlet Pressure	6 psi (Calc.)	Specific Gravity, Solids	1.40
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	87.4	91.6	5.72	1.14
Sink at 1.60	8.0	8.4	53.2	13.2
Composite	95.4	100.0	9.71	2.15
Underflow				
Float at 1.60	0.6	13.1	8.60	1.94
Sink at 1.60	4.0	86.9	69.6	24.6
Composite	4.6	100.0	61.61	21.63
Composite of Cyclone Products	100.0		12.10	3.05
Analysis of Feed to Cyclone			11.0	2.54

Run Date: 12-6-68

TABLE C-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 3, Run No. 5

Run No. 5 BCR Sample No. 1950

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	3.0 in.	Flowrate of Pulp, usgpm	36.8
Inlet Pressure	6 psi (Calc.)	Specific Gravity, Solids	1.39
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	89.4	93.4	5.46	1.12
Sink at 1.60	6.3	6.6	25.4	11.6
Composite	95.7	100.0	6.78	1.81
Underflow				
Float at 1.60	1.8	40.9	8.42	1.89
Sink at 1.60	2.5	59.1	67.0	20.4
Composite	4.3	100.0	43.04	12.83
Composite of Cyclone Products			8.34	2.28
Analysis of Feed to Cyclone			10.2	2.31

Run Date: 12-6-68

TABLE C-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0 Test No. 3, Run No. 6

Run No. 6 BCR Sample No. 1950

Operating Conditions:

Cone Type S
Vortex Finder Clearance 3.5 in.
Inlet Pressure 8 psi (Calc.)
Dry Feed, tph 1.0
Specific Gravity, Pulp 1.02
Flowrate of Pulp, usgpm 55.2
Specific Gravity, Solids 1.40
Weight Percent, Solids 8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	85.2	93.7	5.32	1.11
Sink at 1.60	5.7	6.3	53.4	10.9
Composite	90.9	100.0	8.35	1.73
Underflow				
Float at 1.60	5.5	60.0	8.18	1.77
Sink at 1.60	3.6	40.0	65.6	19.7
Composite	9.1	100.0	31.15	8.94
Composite of Cyclone Products	100.0		10.4	2.39
Analysis of Feed to Cyclone			10.8	2.44

TABLE C-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2031

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	59.6		0.60	5.86	1.64	
Zone B	18.2		0.57	6.52	1.82	
Zone C						
Float at 1.60	3.5	58.7	0.47	12.1	2.80	
Sink at 1.60	2.5	41.3	0.38	40.8	9.14	
Composite	6.0	100.0	0.43	23.95	5.42	
Zone D						
Float at 1.60	0.3	1.8	0.48	13.7	3.06	
Float at 2.95	10.9	75.3	0.52	69.6	8.23	
Sink at 2.95	3.3	22.9	0.32	61.8	39.6	
Composite	14.5	100.0	0.47	66.81	15.32	
Zone E						
Float at 2.95	0.3	16.4	0.70	72.6	12.8	
Sink at 2.95	1.4	83.6	0.24	62.8	42.6	
Composite	1.7	100.0	0.32	64.41	37.71	
Composite of Zones A, B, C	83.8		0.58	7.31	1.95	
Composite of 1.60 Float Fractions	81.6		0.59	6.31	1.74	
Composite of 2.95 Sink Fractions	4.7		0.30	62.10	40.49	
Composite of Table Products	100.0		0.56	16.90	4.50	
Analysis of Feed to Table			2.77	12.4	3.66	

Run Date: 10-11-68

TABLE C-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Zones A, B, and C, 3/8 Inch x 0 Run (10-11-68) Crushed to 30 Mesh x 0

Test No. 5, Run No. 1 BCR Sample No. 2031

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	34.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.36
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	91.1	94.6	4.46	1.18
Sink at 1.60	5.2	5.4	37.0	8.83
Composite	96.3	100.0	6.22	1.59
Underflow				
Float at 1.60	2.9	79.6	6.17	1.30
Sink at 1.60	0.8	20.4	51.8	12.6
Composite	3.7	100.0	15.48	3.61
Composite of Cyclone Products	100.0		6.56	1.66
Analysis of Feed to Cyclone			6.68	1.72

Run Date: 12-10-68

TABLE C-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

BCR Sample No. 2031

Concentrating Table Test Run Date 10-11-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	12.4	3.66		
Composite of Zones A, B, C	83.8	7.31	1.95	41.0	46.7

Compound Water Cyclone Test No. 5, Run No. 1 Run Date 12-10-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC*	100.0	6.56	1.66		
Clean Coal Product	96.3	6.22	1.59	5.2	4.2
Two-Stage Clean Coal Product	80.7	6.22	1.59	49.8	56.6

* Based on Composite of CWC Products

TABLE C-14

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Zones A, B, and C, 3/8 Inch x 0 Run (10-11-68) Crushed to 30 Mesh x 0

Test No. 5, Run No. 2 BCR Sample No. 2031

Operating Conditions:

Cone Type M
Vortex Finder Clearance 1 in.
Inlet Pressure 8 psi
Dry Feed, tph 1.1
Specific Gravity, Pulp 1.02
Flowrate of Pulp, usgpm 55.2
Specific Gravity, Solids 1.37
Weight Percent, Solids 8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	83.5	95.7	4.48	1.21
Sink at 1.60	3.8	4.3	38.2	8.93
Composite	87.3	100.0	5.93	1.54
Underflow				
Float at 1.60	10.8	85.1	7.06	1.34
Sink at 1.60	1.9	14.9	48.6	8.26
Composite	12.7	100.0	13.25	2.37
Composite of Cyclone Products	100.0		6.86	1.65
Analysis of Feed to Cyclone			7.70	1.82

Run Date: 12-20-68

TABLE C-15

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

BCR Sample No. 2031

Concentrating Table Test

Run Date 10-11-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	12.4	3.66		
Composite of Zones A, B, C	83.8	7.31	1.95	41.0	46.7

Compound Water Cyclone Test No. 5, Run No. 2 Run Date 12-20-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC*	100.0	6.86	1.65		
Clean Coal Product	87.3	5.93	1.54	13.6	6.7
Two-Stage Clean Coal Product	73.2	5.93	1.54	52.2	57.9

* Based on Composite of CWC Products

TABLE C-16

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2026

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	40.6		2.58	4.53	1.68	
Zone B	42.5		2.64	4.55	1.64	
Zone C						
Float at 1.60	9.7	88.5	0.95	8.20	2.58	
Sink at 1.60	1.3	11.5	0.79	39.6	13.6	
Composite	11.0	100.0	0.93	11.81	3.85	
Zone D						
Float at 1.60	0.6	11.7	0.83	16.2	3.88	
Float at 2.95	3.7	66.6	1.38	53.0	13.4	
Sink at 2.95	1.2	21.7	0.63	60.0	41.2	
Composite	5.5	100.0	1.15	50.21	18.32	
Zone E						
Float at 2.95	0.04	9.6	0.96	57.2	25.0	
Sink at 2.95	0.36	90.4	0.17	63.0	44.8	
Composite	0.4	100.0	0.25	62.44	42.90	
Composite of Zones A, B, C	94.1		2.41	5.39	1.92	
Composite of 1.60 Float Fractions	93.4		2.43	4.99	1.77	
Composite of 2.95 Sink Fractions	1.6		0.52	60.75	42.10	
Composite of Table Products	100.0		2.34	8.08	2.98	
Analysis of Feed to Table			3.20	7.93	2.90	

Run Date: 10-18-68

TABLE C-17

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (10-18-68) Crushed to 30 Mesh x 0

Test No. 6 BCR Sample No. 2026

Run No. 1

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	34.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.35
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Ash	Chemical Analysis, Dry Basis, Weight Percent: Total Sulfur
Overflow				
Float at 1.60	90.4	96.8	3.74	1.06
Sink at 1.60	3.0	3.2	41.6	17.6
Composite	93.4	100.0	4.95	1.59
Underflow				
Float at 1.60	5.7	86.3	5.36	1.32
Sink at 1.60	0.9	13.7	52.6	27.2
Composite	6.6	100.0	11.83	4.87
Composite of Cyclone Products	100.0		5.40	1.81
Analysis of Feed to Cyclone			5.52	1.77

Run Date: 12-10-68

TABLE C-18

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2026

Concentrating Table Test

Run Date 10-18-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	7.93	2.90		
Composite of Zones A, B, C	94.1	5.39	1.92	32.0	33.8

Compound Water Cyclone Test No. 6, Run No. 1 Run Date 12-10-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC*	100.0	5.40	1.81		
Clean Coal Product	93.4	4.95	1.59	8.3	12.2
Two-Stage Clean Coal Product	87.9	4.95	1.59	37.6	45.2

* Based on Composite of CWC Products

TABLE C-19

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (10-18-68) Crushed to 30 Mesh x 0

Test No. 6, Run No. 2 BCR Sample No. 2026

Run No. 2

Operating Conditions:

Cone Type	M	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	55.2
Inlet Pressure	8 psi	Specific Gravity, Solids	1.36
Dry Feed, tph	1.1	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent Ash	Total Sulfur
Overflow				
Float at 1.60	82.6	96.8	3.63	1.12
Sink at 1.60	2.7	3.2	39.7	16.0
Composite	85.3	100.0	4.78	1.60
Underflow				
Float at 1.60	13.6	92.8	5.62	1.47
Sink at 1.60	1.1	7.2	46.2	17.2
Composite	14.7	100.0	8.54	2.60
Composite of Cyclone Products	100.0		5.33	1.75
Analysis of Feed to Cyclone			6.51	1.94

Run Date: 12-20-68

TABLE C-20

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2026

Concentrating Table Test

Run Date 10-18-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	7.93	2.90		
Composite of Zones A, B, C	94.1	5.39	1.92	32.0	33.8

Compound Water Cyclone Test No. 6, Run No. 2 Run Date 12-20-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC*	100.0	5.33	1.75		
Clean Coal Product	85.3	4.78	1.60	10.3	8.6
Two-Stage Clean Coal Product	80.3	4.78	1.60	39.7	44.8

* Based on Composite of CWC Products

TABLE C-21

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2012

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	55.5		0.72	5.44	1.30	
Zone B	22.2		0.64	6.08	1.50	
Zone C						
Float at 1.60	3.3	56.1	0.47	13.0	3.28	
Sink at 1.60	2.5	43.9	0.60	47.6	6.97	
Composite	5.8	100.0	0.53	28.19	4.90	
Zone D						
Float at 1.60	0.2	1.5	0.54	13.5	3.94	
Float at 2.95	13.3	87.7	0.86	77.2	5.44	
Sink at 2.95	1.7	10.8	0.61	63.4	36.1	
Composite	15.2	100.0	0.83	74.75	8.73	
Zone E						
Float at 2.95	0.4	27.4	0.70	78.4	11.1	
Sink at 2.95	0.9	72.6	0.34	62.5	41.5	
Composite	1.3	100.0	0.44	66.86	33.17	
Composite of Zones A, B, C	83.5		0.69	7.18	1.60	
Composite of 1.60 Float Fractions	81.2		0.69	5.94	1.44	
Composite of 2.95 Sink Fractions	2.6		0.52	63.09	37.97	
Composite of Table Products	100.0		0.70	18.24	3.10	
Analysis of Feed to Table			1.78	17.7	3.30	

Run Date: 11-6-68

TABLE C-22

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Zones A. B. and C, 3/8 Inch x 0 Run (11-6-68) Crushed to 30 Mesh x 0

Test No. 4, Run No. 1 BCR Sample No. 2012

Operating Conditions: Run No. 1

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	34.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.36
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	89.4	94.8	4.32	0.96
Sink at 1.60	4.9	5.2	44.4	10.0
Composite	94.3	100.0	6.40	1.43
Underflow				
Float at 1.60	4.1	71.8	6.52	1.33
Sink at 1.60	1.6	28.2	58.2	16.8
Composite	5.7	100.0	21.09	5.69
Composite of Cyclone Products	100.0		7.24	1.67
Analysis of Feed to Cyclone			6.85	1.57

Run Date: 12-10-68

TABLE C-23

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

BCR Sample No. 2012

Concentrating Table Test   Run Date 11-6-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	17.7	3.30		
Composite of Zones A, B, C	83.5	7.18	1.60	59.4	51.5

Compound Water Cyclone Test No. 4, Run No. 1   Run Date 12-10-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *	100.0	7.24	1.67		
Clean Coal Product	94.3	6.40	1.43	11.6	14.4
Two-Stage Clean Coal Product	78.7	6.40	1.43	63.8	56.7

* Based on Composite of CWC Products

TABLE C-24

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

BCR Sample No. 2012

Concentrating Table Test Run Date 11-6-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	17.7	3.30		
Composite of Zones A, B, C	83.5	7.18	1.60	59.4	51.5

Compound Water Cyclone Test No. 4, Run No. 2 Run Date 12-20-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *	100.0	6.74	1.46		
Clean Coal Product	83.7	5.68	1.23	15.7	15.7
Two-Stage Clean Coal Product	69.9	5.68	1.23	67.9	62.7

* Based on Composite of CWC Products

TABLE C-25

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Zones A. B, and C, 3/8 Inch x 0 Run (11-6-68) Crushed to 30 Mesh x 0

Test No. 4, Run No. 2 BCR Sample No. 2012

Run No. 2

Operating Conditions:

Cone Type	M	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	55.2
Inlet Pressure	8 psi	Specific Gravity, Solids	1.37
Dry Feed, tph	1.1	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	80.7	96.4	4.26	0.92
Sink at 1.60	3.0	3.6	43.8	9.50
Composite	83.7	100.0	5.68	1.23
Underflow				
Float at 1.60	14.3	87.8	6.18	1.20
Sink at 1.60	2.0	12.2	55.6	13.0
Composite	16.3	100.0	12.21	2.64
Composite of Cyclone Products	100.0		6.74	1.46
Analysis of Feed to Cyclone			8.17	1.76

Run Date: 12-20-68

TABLE C-26

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2013

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	33.2		1.28	8.00	2.84	
Zone B	43.8		1.23	7.94	3.00	
Zone C						
Float at 1.60	11.3	85.3	1.74	10.6	3.49	
Sink at 1.60	2.0	14.7	1.33	43.5	6.58	
Composite	13.3	100.0	1.68	15.44	3.94	
Zone D						
Float at 1.60	0.5	5.5	0.53	19.2	4.92	
Float at 2.95	8.1	86.4	0.90	68.2	6.52	
Sink at 2.95	0.8	8.1	0.46	59.4	38.2	
Composite	9.4	100.0	0.84	64.79	9.00	
Zone E						
Float at 2.95	0.1	18.9	1.06	70.2	17.2	
Sink at 2.95	0.2	81.1	0.41	62.0	40.7	
Composite	0.3	100.0	0.53	63.55	36.26	
Composite of Zones A, B, C	90.3		1.31	9.06	3.08	
Composite of 1.60 Float Fractions	88.8		1.31	8.37	3.01	
Composite of 2.95 Sink Fractions	1.0		0.45	59.92	38.70	
Composite of Table Products	100.0		1.27	14.47	3.74	
Analysis of Feed to Table			3.15	15.2	3.98	

Run Date: 11-27-68

TABLE C-27

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (11-27-68) Crushed to 30 Mesh x 0

Test No. 7, Run No. 1 BCR Sample No. 2013

Run No. 1

Operating Conditions:

Cone Type	S	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	34.2
Inlet Pressure	5 psi	Specific Gravity, Solids	1.38
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	92.6	95.8	6.36	2.34
Sink at 1.60	4.1	4.2	42.5	14.2
Composite	96.7	100.0	7.88	2.84
Underflow				
Float at 1.60	2.9	86.9	8.54	2.83
Sink at 1.60	0.4	13.1	43.1	15.3
Composite	3.3	100.0	13.07	4.46
Composite of Cyclone Products	100.0		8.05	2.89
Analysis of Feed to Cyclone			8.60	3.02

Run Date: 12-30-68

TABLE C-28

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

BCR Sample No. 2013

Concentrating Table Test

Run Date 11-27-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	15.2	3.98		
Composite of Zones A, B, C	90.3	9.06	3.08	40.4	22.6

Compound Water Cyclone Test No. 7, Run No. 1 Run Date 12-30-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC*	100.0	8.05	2.89		
Clean Coal Product	96.7	7.88	2.84	2.1	1.7
Two-Stage Clean Coal Product	87.3	7.88	2.84	48.2	28.6

* Based on Composite of CWC Products

TABLE C-29

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (11-27-68) Crushed to 30 Mesh x 0

Test No. 7, Run No. 2

BCR Sample No. 2013

Run No. 2

Operating Conditions:

Cone Type	M	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	55.2
Inlet Pressure	8 psi	Specific Gravity, Solids	1.39
Dry Feed, tph	1.1	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	84.4	96.7	5.95	2.26
Sink at 1.60	2.9	3.3	39.2	12.6
Composite	87.3	100.0	7.05	2.60
Underflow				
Float at 1.60	11.7	92.0	8.64	2.90
Sink at 1.60	1.0	8.0	42.2	13.1
Composite	12.7	100.0	11.32	3.72
Composite of Cyclone Products	100.0		7.59	2.74
Analysis of Feed to Cyclone			8.91	3.00

Run Date: 12-30-68

TABLE C-30

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

BCR Sample No. 2013

Concentrating Table Test Run Date 11-27-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	15.2	3.98		
Composite of Zones A, B, C	90.3	9.06	3.08	40.4	22.6

Compound Water Cyclone Test No. 7, Run No. 2 Run Date 12-30-68

Feed to Compound Water Cyclone: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *	100.0	7.59	2.74		
Clean Coal Product	87.3	7.05	2.60	7.1	5.1
Two-Stage Clean Coal Product	78.8	7.05	2.60	53.6	34.7

* Based on Composite of CWC Products

TABLE D-1

Evaluation of Coal Cleaning Process and Techniques for Removing Pyritic Sulfur from Fine Coal

Spiral Concentrator Tests

Single-Stage Cleaning

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 30 Mesh x 0, Test No. 1, Run No. 1

BCR Sample No. 1950

Operating Conditions:

Splitter Nos.	9-2, 12-2, 15-2	Specific Gravity, Pulp	1.07
Inlet Pressure, psi	9	Flowrate of Pulp, usgpm	21.6
Dry Feed, tph	1.1	Weight Percent, Solids	24.6
Middling Split, mesh	100	Specific Gravity, Solids	1.40

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal				
Float at 1.60	69.3	94.8	6.30	1.14
Sink at 1.60	3.8	5.2	39.30	9.46
Composite	73.1	100.0	8.02	1.57
Middling Oversize				
Float at 1.60	13.9	93.7	6.13	1.25
Sink at 1.60	0.9	6.3	39.40	6.70
Composite	14.8	100.0	8.23	1.59
Middling Undersize				
Float at 1.60	6.0	87.0	6.76	1.00
Sink at 1.60	0.9	13.0	53.20	14.20
Composite	6.9	100.0	12.80	2.72
Refuse				
Float at 1.60	2.9	55.8	7.32	1.32
Sink at 1.60	2.3	44.2	65.80	15.40
Composite	5.2	100.0	33.17	7.54
Composite of Concentrator Products	100.0		9.69	1.96
Analysis of Feed to Concentrator			11.20	2.54

Run Date: 11-25-68

15.3 percent reduction in total sulfur at 94.8 percent recovery.

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TABLE D-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2031

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	59.6		0.60	5.86	1.64	
Zone B	18.2		0.57	6.52	1.82	
Zone C						
Float at 1.60	3.5	58.7	0.47	12.1	2.80	
Sink at 1.60	2.5	41.3	0.38	40.8	9.14	
Composite	6.0	100.0	0.43	23.95	5.42	
Zone D						
Float at 1.60	0.3	1.8	0.48	13.7	3.06	
Float at 2.95	10.9	75.3	0.52	69.6	8.23	
Sink at 2.95	3.3	22.9	0.32	61.8	39.6	
Composite	14.5	100.0	0.47	66.81	15.32	
Zone E						
Float at 2.95	0.3	16.4	0.70	72.6	12.8	
Sink at 2.95	1.4	83.6	0.24	62.8	42.6	
Composite	1.7	100.0	0.32	64.41	37.71	
Composite of Zones A, B, C	83.8		0.58	7.31	1.95	
Composite of 1.60 Float Fractions	81.6		0.59	6.31	1.74	
Composite of 2.95 Sink Fractions	4.7		0.30	62.10	40.49	
Composite of Table Products	100.0		0.56	16.90	4.50	
Analysis of Feed to Table			2.77	12.4	3.66	

Run Date: 10-11-68

TABLE D-3

Evaluation of Coal Cleaning Process and Techniques for Removing Pyritic Sulfur from Fine Coal

Humphreys Spiral Concentrator Tests

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

Zones A, B, and C, 3/8 Inch x 0 Run (10-11-68) Crushed to 30 Mesh x 0

Test No. 3, Run No. 1

BCR Sample No. 2031

Operating Conditions:

Splitter Nos. 6-3, 9-2, 12-2, 15-1
Inlet Pressure, psi 10
Dry Feed, tph 1.6
Middling Split, mesh 100

Specific Gravity, Pulp 1.07
Flowrate of Pulp, usgpm 31.8
Weight Percent, Solids 24.6
Specific Gravity, Solids 1.36

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal				
Float at 1.60	74.0	96.9	4.52	1.01
Sink at 1.60	2.4	3.1	40.9	8.52
Composite	76.4	100.0	5.65	1.24
Middling Oversize				
Float at 1.60	10.8	95.9	4.76	1.06
Sink at 1.60	0.5	4.1	42.0	6.45
Composite	11.3	100.0	6.29	1.28
Middling Undersize				
Float at 1.60	5.3	93.1	4.22	0.85
Sink at 1.60	0.4	6.9	48.3	12.8
Composite	5.7	100.0	7.26	1.67
Refuse				
Float at 1.60	4.7	71.1	5.72	1.17
Sink at 1.60	1.9	28.9	57.0	17.1
Composite	6.6	100.0	20.54	5.77
Composite of Concentrator Products	100.0		6.80	1.57
Analysis of Feed to Concentrator			6.66	1.71

Run Date: 12-23-68

TABLE D-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Spiral Concentrator Tests
Effects of Two-Stage Cleaning

Coal Identification LOWER KITTANNING SEAM, INDIANA COUNTY, PENNSYLVANIA

BCR Sample No. 2031

Concentrating Table Test

Run Date 10-11-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	12.4	3.66		
Composite of Zones A, B, C	83.8	7.31	1.95	41.0	46.7

Spiral Concentrator Test No. 3, Run No. 1 Run Date 12-23-68

Feed to Spiral Concentrator: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to SC *	100.0	6.80	1.57		
Clean Coal Product	93.4	5.83	1.27	14.3	19.1
Two-Stage Clean Coal Product	78.3	5.83	1.27	53.0	65.3

* Based on Composite of SC Products

TABLE D-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2026

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	40.6		2.58	4.53	1.68	
Zone B	42.5		2.64	4.55	1.64	
Zone C						
Float at 1.60	9.7	88.5	0.95	8.20	2.58	
Sink at 1.60	1.3	11.5	0.79	39.6	13.6	
Composite	11.0	100.0	0.93	11.81	3.85	
Zone D						
Float at 1.60	0.6	11.7	0.83	16.2	3.88	
Float at 2.95	3.7	66.6	1.38	53.0	13.4	
Sink at 2.95	1.2	21.7	0.63	60.0	41.2	
Composite	5.5	100.0	1.15	50.21	18.32	
Zone E						
Float at 2.95	0.04	9.6	0.96	57.2	25.0	
Sink at 2.95	0.36	90.4	0.17	63.0	44.8	
Composite	0.4	100.0	0.25	62.44	42.90	
Composite of Zones A, B, C	94.1		2.41	5.39	1.92	
Composite of 1.60 Float Fractions	93.4		2.43	4.99	1.77	
Composite of 2.95 Sink Fractions	1.6		0.52	60.75	42.10	
Composite of Table Products	100.0		2.34	8.08	2.8	
Analysis of Feed to Table			3.20	7.93	2.90	

Run Date: 10-18-68

TABLE D-6

Evaluation of Coal Cleaning Process and Techniques for Removing Pyritic Sulfur from Fine Coal

Spiral Concentrator Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (10-18-68) Crushed to 30 Mesh x 0

Test No. 4, Run No. 1

BCR Sample No. 2026

Operating Conditions:

Splitter Nos. 6-3, 9-2, 12-2, 15-1
Inlet Pressure, psi 10
Dry Feed, tph 1.6
Middling Split, mesh 100

Specific Gravity, Pulp 1.07
Flowrate of Pulp, usgpm 31.8
Weight Percent, Solids 24.6
Specific Gravity, Solids 1.35

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal	75.4	97.2	3.82	1.03
Float at 1.60	2.2	2.8	40.4	16.7
Sink at 1.60	77.6	100.0	4.84	1.47
Composite				
Middling Oversize				
Float at 1.60	9.1	97.9	4.22	1.18
Sink at 1.60	0.2	2.1	36.9	7.67
Composite	9.3	100.0	4.91	1.32
Middling Undersize				
Float at 1.60	7.5	94.3	3.18	0.96
Sink at 1.60	0.5	5.7	44.0	20.0
Composite	8.0	100.0	5.51	2.05
Refuse				
Float at 1.60	4.0	77.5	4.90	1.32
Sink at 1.60	1.1	22.5	53.9	23.4
Composite	5.1	100.0	15.93	6.29
Composite of Concentrator Products	100.0		5.47	1.75
Analysis of Feed to Concentrator			5.14	1.66

Run Date: 12-23-68

TABLE D-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Spiral Concentrator Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2026

Concentrating Table Test

Run Date 10-18-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	7.93	2.90		
Composite of Zones A, B, C	94.1	5.39	1.92	32.0	33.8

Spiral Concentrator Test No. 4, Run No. 1 Run Date 12-23-68

Feed to Spiral Concentrator: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to SC *	100.0	5.47	1.75		
Clean Coal Product	94.9	4.90	1.50	10.4	14.3
Two-Stage Clean Coal Product	89.3	4.90	1.50	38.2	48.3

* Based on Composite of SC Products

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TABLE D-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2012

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	55.5		0.72	5.44	1.30	
Zone B	22.2		0.64	6.08	1.50	
Zone C						
Float at 1.60	3.3	56.1	0.47	13.0	3.28	
Sink at 1.60	2.5	43.9	0.60	47.6	6.97	
Composite	5.8	100.0	0.53	28.19	4.90	
Zone D						
Float at 1.60	0.2	1.5	0.54	13.5	3.94	
Float at 2.95	13.3	87.7	0.86	77.2	5.44	
Sink at 2.95	1.7	10.8	0.61	63.4	36.1	
Composite	15.2	100.0	0.83	74.75	8.73	
Zone E						
Float at 2.95	0.4	27.4	0.70	78.4	11.1	
Sink at 2.95	0.9	72.6	0.34	62.5	41.5	
Composite	1.3	100.0	0.44	66.86	33.17	
Composite of Zones A, B, C	83.5		0.69	7.18	1.60	
Composite of 1.60 Float Fractions	81.2		0.69	5.94	1.44	
Composite of 2.95 Sink Fractions	2.6		0.52	63.09	37.97	
Composite of Table Products	100.0		0.70	18.24	3.10	
Analysis of Feed to Table			1.78	17.7	3.30	

Run Date: 11-6-68

TABLE D-9

Evaluation of Coal Cleaning Process and Techniques for Removing Pyritic Sulfur from Fine Coal

Spiral Concentrator Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Zones A, B, and C, 3/8 Inch x 0 Run (11-6-68) Crushed to 30 Mesh x 0

Test No. 2, Run No. 1

BCR Sample No. 2012

Operating Conditions:

Splitter Nos. 6-4, 9-3, 12-2, 15-1
Inlet Pressure, psi 10
Dry Feed, tph 1.6
Middling Split, mesh 100

Specific Gravity, Pulp 1.07
Flowrate of Pulp, usgpm 31.8
Weight Percent, Solids 24.6
Specific Gravity, Solids 1.36

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal				
Float at 1.60	71.8	95.9	4.84	1.18
Sink at 1.60	3.1	4.1	40.0	8.68
Composite	74.9	100.0	6.28	1.49
Middling Oversize				
Float at 1.60	9.4	94.2	5.80	1.22
Sink at 1.60	0.6	5.8	40.0	5.02
Composite	10.0	100.0	7.78	1.44
Middling Undersize				
Float at 1.60	7.8	93.0	4.05	1.09
Sink at 1.60	0.6	7.0	37.3	9.74
Composite	8.4	100.0	6.38	1.70
Refuse				
Float at 1.60	4.9	73.3	6.26	1.31
Sink at 1.60	1.8	26.7	53.6	9.53
Composite	6.7	100.0	18.90	3.50
Composite of Concentrator Products	100.0		7.28	1.64
Analysis of Feed to Concentrator			6.22	1.42

Run Date: 12-23-68

TABLE D-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Spiral Concentrator Tests
Effects of Two-Stage Cleaning

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

BCR Sample No. 2012

Concentrating Table Test Run Date 11-6-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	17.7	3.30		
Composite of Zones A, B, C	83.5	7.18	1.60	59.4	51.5

Spiral Concentrator Test No. 2, Run No. 1 Run Date 12-23-68

Feed to Spiral Concentrator: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to SC*	100.0	7.28	1.64		
Clean Coal Product	93.3	6.45	1.50	11.4	8.5

Two-Stage Clean Coal Product	77.9	6.45	1.50	63.6	54.5

* Based on Composite of SC Products

TABLE D-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2013

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	33.2		1.28	8.00	2.84	
Zone B	43.8		1.23	7.94	3.00	
Zone C						
Float at 1.60	11.3	85.3	1.74	10.6	3.49	
Sink at 1.60	2.0	14.7	1.33	43.5	6.58	
Composite	13.3	100.0	1.68	15.44	3.94	
Zone D						
Float at 1.60	0.5	5.5	0.53	19.2	4.92	
Float at 2.95	8.1	86.4	0.90	68.2	6.52	
Sink at 2.95	0.8	8.1	0.46	59.4	38.2	
Composite	9.4	100.0	0.84	64.79	9.00	
Zone E						
Float at 2.95	0.1	18.9	1.06	70.2	17.2	
Sink at 2.95	0.2	81.1	0.41	62.0	40.7	
Composite	0.3	100.0	0.53	63.55	36.26	
Composite of Zones A, B, C	90.3		1.31	9.06	3.08	
Composite of 1.60 Float Fractions	88.8		1.31	8.37	3.01	
Composite of 2.95 Sink Fractions	1.0		0.45	59.92	38.70	
Composite of Table Products	100.0		1.27	14.47	3.74	
Analysis of Feed to Table			3.15	15.2	3.98	

Run Date: 11-27-68

TABLE D-12

Evaluation of Coal Cleaning Process and Techniques
for Removing Pyritic Sulfur from Fine Coal

Spiral Concentrator Tests

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

Zones A, B, and C, 3/8 Inch x 0 Run (11-27-68) Crushed to 30 Mesh x 0

Test No. 5, Run No. 1 BCR Sample No. 2013

Operating Conditions:

Splitter Nos.	6-3, 9-2, 12-2, 15-1	Specific Gravity, Pulp	1.07
Inlet Pressure, psi	10	Flowrate of Pulp, usgpm	31.8
Dry Feed, tph	1.6	Weight Percent, Solids	24.6
Middling Split, mesh	100	Specific Gravity, Solids	1.38

Concentrator Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Clean Coal				
Float at 1.60	78.4	95.9	6.26	2.32
Sink at 1.60	3.3	4.1	42.1	15.0
Composite	81.7	100.0	7.73	2.84
Middling Oversize				
Float at 1.60	7.3	97.4	6.74	2.54
Sink at 1.60	0.2	2.6	36.6	7.76
Composite	7.5	100.0	7.52	2.68
Middling Undersize				
Float at 1.60	6.7	93.1	6.01	2.04
Sink at 1.60	0.5	6.9	47.4	18.6
Composite	7.2	100.0	8.87	3.18
Refuse				
Float at 1.60	3.1	86.1	7.34	2.52
Sink at 1.60	0.5	13.9	50.0	24.2
Composite	3.6	100.0	13.27	5.53
Composite of Concentrator Products	100.0		8.00	2.95
Analysis of Feed to Concentrator			8.42	3.02

Run Date: 12-30-68

TABLE D-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Spiral Concentrator Tests
Effects of Two-Stage Cleaning

Coal Identification NO. 8 SEAM, JEFFERSON COUNTY, OHIO

BCR Sample No. 2013

Concentrating Table Test

Run Date 11-27-68

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table	100.0	15.2	3.98		
Composite of Zones A, B, C	90.3	9.06	3.08	40.4	22.6

Spiral Concentrator Test No. 5, Run No. 1 Run Date 12-30-68

Feed to Spiral Concentrator: Concentrating Table Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to SC *	100.0	8.00	2.95		
Clean Coal Product	96.4	7.80	2.85	2.5	3.4
Two-Stage Clean Coal Product	87.0	7.08	2.85	53.4	28.4

* Based on Composite of SC Products

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TABLE E-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification NO. 6 SEAM, PERRY COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1730

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	62.0	0.0	0.3	7.1	24.7	67.9
Coarse Coal Fraction	38.0	0.6	20.8	57.8	18.4	2.4
Composite	100.0	0.2	8.1	26.4	22.3	43.0

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	73.8	6.76	1.56	0.49
Sink at 1.60	26.2	55.3	10.3	9.71
Composite	100.0	19.48	3.85	2.91

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
86.8	66.9

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	79.5	6.40	1.74	0.64
Sink at 1.60	20.5	57.0	16.1	16.1
Composite	100.0	16.77	4.68	3.81

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
82.7	63.1

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	19.48	3.85	2.91
Coarse Coal Fraction, 1.60 Float	6.40	1.74	0.64
Composite, 100% Weight Basis	15.19	3.16	2.17

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
41.4	33.1

TABLE E-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification NO. 8 SEAM, BELMONT COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1733

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	60.8	0.0	0.5	4.9	24.3	70.3
Coarse Coal Fraction	39.2	0.3	15.2	56.5	22.0	6.0
Composite	100.0	0.1	6.3	25.1	23.4	45.1

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	65.3	6.90	2.78	0.71
Sink at 1.60	34.7	70.7	5.68	5.18
Composite	100.0	29.04	3.79	2.26

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
75.0	39.3

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	68.4	7.22	3.36	1.24
Sink at 1.60	31.6	71.4	10.5	10.2
Composite	100.0	27.50	5.62	4.07

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
56.3	26.6

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	29.04	3.79	2.26
Coarse Coal Fraction, 1.60 Float	7.22	3.36	1.24
Composite, 100% Weight Basis	22.98	3.66	1.95

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
31.3	20.1

TABLE E-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification NO. 6-A SEAM, HARRISON COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1735

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	63.2	0.0	0.8	5.0	19.3	74.9
Coarse Coal Fraction	36.8	0.3	17.7	55.2	22.4	4.4
Composite	100.0	0.1	7.0	23.5	20.4	49.0

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	85.7	4.23	0.88	0.15
Sink at 1.60	14.3	48.4	8.82	8.37
Composite	100.0	10.55	2.02	1.32

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
91.9	64.8

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	81.4	4.77	0.88	0.26
Sink at 1.60	18.6	61.0	18.2	18.9
Composite	100.0	15.23	4.10	3.73

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
86.0	64.8

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	10.55	2.02	1.32
Coarse Coal Fraction, 1.60 Float	4.77	0.88	0.26
Composite, 100% Weight Basis	8.69	1.65	0.98

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
47.3	34.0

TABLE E-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1745

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	65.1	0.0	0.2	4.3	24.2	71.3
Coarse Coal Fraction	34.9	0.2	11.0	55.3	27.6	5.9
Composite	100.0	0.1	4.0	22.1	25.4	48.4

Analyses of Fine Coal Fraction:

	Float and Sink, Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	87.6	3.04	0.59	0.14
Sink at 1.60	12.4	44.9	10.1	9.73
Composite	100.0	8.23	1.77	1.33

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
92.2	75.8

Analyses of Coarse Coal Fraction:

	Float and Sink, Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	83.7	3.98	0.76	0.30
Sink at 1.60	16.3	48.0	18.8	18.8
Composite	100.0	11.16	3.70	3.32

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
83.2	68.9

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	8.23	1.77	1.33
Coarse Coal Fraction, 1.60 Float	3.98	0.76	0.30
Composite, 100% Weight Basis	6.91	1.46	1.01

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
43.6	40.2

TABLE E-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification LOWER KITTANNING AND LOWER FREEPORT SEAM, CAMBRIA CO., PA.

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Sample No. 1747

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	64.4	0.0	0.3	2.7	17.3	79.7
Coarse Coal Fraction	35.6	3.7	16.3	44.5	31.8	3.7
Composite	100.0	1.3	6.0	17.6	22.5	52.6

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	85.8	4.00	0.82	0.20
Sink at 1.60	14.2	51.4	8.96	8.60
Composite	100.0	10.73	1.98	1.39

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
89.1	66.1

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	73.8	5.50	0.85	0.31
Sink at 1.60	26.2	66.8	8.60	8.44
Composite	100.0	21.56	2.88	2.44

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
83.2	64.9

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	10.73	1.98	1.39
Coarse Coal Fraction, 1.60 Float	5.50	0.85	0.31
Composite, 100% Weight Basis	9.21	1.65	1.08

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
41.3	31.8

TABLE E-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification UPPER FREEPORT SEAM, WESTMORELAND COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1750

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	63.6	0.0	0.3	4.4	25.1	70.2
Coarse Coal Fraction	36.4	0.2	13.4	56.5	27.8	2.1
Composite	100.0	0.1	5.1	23.4	26.1	45.3

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	78.1	4.55	0.82	0.32
Sink at 1.60	21.9	58.2	7.34	6.91
Composite	100.0	16.30	2.25	1.76

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
90.1	78.1

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	54.8	5.60	1.10	0.60
Sink at 1.60	45.2	68.1	13.0	13.1
Composite	100.0	33.85	6.48	6.25

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
81.4	70.6

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	16.30	2.25	1.76
Coarse Coal Fraction, 1.60 Float	5.60	1.10	0.60
Composite, 100% Weight Basis	13.75	1.98	1.48

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
54.0	47.1

TABLE E-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1752

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	67.8	0.0	0.3	3.7	19.6	76.4
Coarse Coal Fraction	32.2	1.1	10.5	44.5	37.0	6.9
Composite	100.0	0.4	3.6	16.8	25.2	54.0

Analyses of Fine Coal Fraction:

Float and Sink, Weight %		Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	84.2	5.26	0.53	0.15
Sink at 1.60	15.8	45.4	7.02	6.82
Composite	100.0	11.60	1.56	1.20

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
93.5	80.4

Analyses of Coarse Coal Fraction:

Float and Sink, Weight %		Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	70.2	7.96	0.54	0.15
Sink at 1.60	29.8	59.8	13.4	13.0
Composite	100.0	23.41	4.37	3.98

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
93.5	80.1

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	11.60	1.56	1.20
Coarse Coal Fraction, 1.60 Float	7.96	0.54	0.15
Composite, 100% Weight Basis	10.69	1.31	0.94

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
59.3	51.7

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TABLE E-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests (Reproducibility Test)

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1752

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	68.2	0.0	0.4	2.4	18.6	78.6
Coarse Coal Fraction	31.8	0.8	9.6	42.3	39.5	7.8
Composite	100.0	0.2	3.3	15.1	25.3	56.1

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	86.6	5.05	0.48	0.11
Sink at 1.60	13.4	48.2	6.93	6.86
Composite	100.0	10.83	1.34	1.01

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
95.2	82.3

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	68.5	7.69	0.52	0.15
Sink at 1.60	31.5	58.6	13.8	13.8
Composite	100.0	23.73	4.70	4.45

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
93.5	80.8

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	10.83	1.34	1.01
Coarse Coal Fraction, 1.60 Float	7.69	0.52	0.15
Composite, 100% Weight Basis	10.07	1.14	0.80

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
65.4	57.9

TABLE E-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification FREEPORT SEAM, GRANT COUNTY, WEST VIRGINIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1757

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	60.2	0.0	0.0	3.7	22.2	74.3
Coarse Coal Fraction	39.8	4.7	24.0	48.0	19.8	3.5
Composite	100.0	1.9	9.5	21.2	21.3	46.1

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	66.1	8.85	0.96	0.32
Sink at 1.60	33.9	61.8	4.41	4.18
Composite	100.0	26.80	2.13	1.63

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
85.2	61.9

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	43.4	12.6	1.10	0.54
Sink at 1.60	56.6	70.6	4.19	4.13
Composite	100.0	45.43	2.85	2.57

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
75.0	56.3

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	26.80	2.13	1.63
Coarse Coal Fraction, 1.60 Float	12.60	1.10	0.54
Composite, 100% Weight Basis	23.63	1.90	1.39

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
35.6	24.6

TABLE E-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification THICK FREEPORT SEAM, ALLEGHENY COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1770

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	71.5	0.0	0.5	4.2	22.0	73.3
Coarse Coal Fraction	28.5	0.2	12.5	59.3	24.6	3.4
Composite	100.0	0.1	4.0	19.9	22.7	53.3

Analyses of Fine Coal Fraction:

Float and Sink, Weight %		Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	76.7	6.65	0.54	0.14
Sink at 1.60	23.3	62.6	4.32	4.25
Composite	100.0	19.69	1.42	1.10

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
91.7	74.0

Analyses of Coarse Coal Fraction:

Float and Sink, Weight %		Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	68.1	8.12	0.60	0.26
Sink at 1.60	31.9	64.3	7.64	7.37
Composite	100.0	26.04	2.85	2.53

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
84.5	71.2

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	19.69	1.42	1.10
Coarse Coal Fraction, 1.60 Float	8.12	0.60	0.26
Composite, 100% Weight Basis	17.23	1.25	0.92

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
45.2	39.1

TABLE E-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

BCR-Majac Air Classification Tests

Coal Identification LOWER FREEPORT SEAM, ARMSTRONG COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1771

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	63.0	0.0	0.2	4.5	21.5	73.3
Coarse Coal Fraction	37.0	0.6	20.0	54.0	21.7	2.8
Composite	100.0	0.2	7.5	23.3	21.8	47.2

Analyses of Fine Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	86.2	5.08	0.72	0.17
Sink at 1.60	13.8	45.8	8.50	8.30
Composite	100.0	10.70	1.79	1.29

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
91.0	71.7

Analyses of Coarse Coal Fraction:

Float and Sink,	Weight %	Chemical Analysis, Dry Basis		
		Ash	Total Sulfur	Pyritic Sulfur
Float at 1.60	79.9	7.84	0.86	0.33
Sink at 1.60	20.1	51.4	12.6	11.8
Composite	100.0	16.60	3.22	2.64

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
82.5	66.1

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis		
	Ash	Total Sulfur	Pyritic Sulfur
Fine Raw Coal Fraction	10.70	1.79	1.29
Coarse Coal Fraction, 1.60 Float	7.84	0.86	0.33
Composite, 100% Weight Basis	9.78	1.49	0.98

Weight % Reduction	
Pyritic Sulfur	Total Sulfur
48.1	41.3

TABLE E-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Alpine Zigzag Classifier Tests
Run No. 4

Coal Identification NO. 8 SEAM, BELMONT COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 1733

Size Consist Analysis (BCR-Majac Products):

	Weight %, Product	Weight % In Screen Size				
		+30	30 x 50	50 x 100	100 x 200	-200
Fine Coal Fraction	60.3	0.0	0.0	6.6	30.2	63.2
Coarse Coal Fraction	39.7	0.7	18.2	58.1	16.9	6.1
Composite	100.0	0.3	7.2	27.0	24.9	40.6

Analyses of Fine Coal Fraction:

	Float and Sink, Weight %	Chemical Analysis, Dry Basis			Weight % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	68.2	6.46	2.91	0.73	74.3	36.5
Sink at 1.60	31.8	65.8	6.34	5.32		
Composite	100.0	25.33	4.00	2.19		

Analyses of Coarse Coal Fraction:

	Float and Sink, Weight %	Chemical Analysis, Dry Basis			Weight % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	67.0	7.22	3.38	1.18	58.5	26.2
Sink at 1.60	33.0	69.5	9.71	9.04		
Composite	100.0	27.77	5.47	3.77		

Chemical Analysis Composite of Fine Raw Coal Fraction and Coarse Clean Coal Fraction:

	Chemical Analysis, Dry Basis			Weight % Reduction	
	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Fine Raw Coal Fraction	25.33	4.00	2.19	33.1	16.6
Coarse Coal Fraction, 1.60 Float	7.22	3.38	1.18		
Composite, 100% Weight Basis	20.20	3.82	1.90		

APPENDIX F

BCR STANDARD METHODS

F-1

FLOAT-AND-SINK ANALYSIS OF FINE COAL

June 9, 1967

SCOPE:

This method is a heavy-media gravity separation by centrifuge to determine the weight percent float and weight percent sink of a sample of fine coal (minus 14 mesh, U.S. Sieve Series).

MODIFIED: September 12, 1967

Included in the standard method is a procedure to deter agglomeration of fine coal particles.

APPARATUS:

Balance with sufficient sensitivity to weigh 200 g to the nearest 0.1 g.
Centrifuge (International Centrifuge, Size 2, Model V)
Heavy-media and gravity adjusting solution:

Methanol	CH_3OH	-	0.80
Tetrachloroethylene	C_2Cl4	-	1.62
Tetrabromoethane	$CHBr_2 \cdot CHBr_2$	-	2.95

Wetting agent--Coal Dyne 80 (Preiser Scientific, Inc.)
Hydrometers capable of measuring specific gravities from 1.00 to 3.00.
Fluted filtering funnels and/or fluted filter paper, Eaton-Dikeman, grade 515, 38.5 cms.
Filtering funnel rack
2000 ml beakers and wash bottle
Small scoop
Stopper for centrifuge tubes
Drying oven 105 C.

PROCEDURE:

1. Record all data on the Data Sheet (sample attached)

2. Adjust heavy-media solution to desired separating gravity. The standard starting solution is tetrachloroethylene (Specific Gravity 1.62). A lighter media is obtained by

adding methanol (0.80); a heavier media is obtained by adding tetrabromoethane (2.95). If mixing of solutions is required, the adjusting solutions should be carefully added in small increments. stirred well, and checked with the appropriate hydrometer until the desired separating gravity is obtained.

3. Weigh four increments of coal (approximately 15 grams each) and place in drying oven for 1 hour at 105 C.
4. Fill centrifuge tubes to halfway with gravity media.
5. Pour the dried increments of coal into the centrifuge tubes (one increment per tube), add 20 drops of Coal Dyne 80 and stir well.
6. Fill centrifuge tubes and adjust weights of opposing centrifuge tubes by adding gravity media, keeping the height of the media in the centrifuge tubes to about 1 inch from the top.
7. Place centrifuge tubes containing gravity media and coal sample into appropriate holders (equal opposing weights) and centrifuge at 1500 rpm for 20 minutes.
8. Weigh filter paper, record weight on data sheet, and place into filtering funnels.
9. After centrifuging, remove centrifuge tube and sample. Scoop off enough float fraction to permit insertion of centrifuge tube stopper. Wash float fraction of coal into filtering funnel marked float using media of same gravity.
10. Remove stopper and wash sink fraction of coal into filtering funnel marked sink using media of same gravity. Care must be taken to wash the float and sink fractions into the appropriate filtering funnel.
11. After most of the separating media has been filtered into the beakers, combine separating media solution and save for future use.
12. Wash the float and sink fractions three times with methanol to remove most of the separating media. This solution will be discarded.
13. After methanol wash, identify filter papers containing coal float and sink fractions and place into drying oven (105 C).

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14. After dry, weigh float and sink fractions; record weight on Data Sheet and calculate to percentages.

15. Save float and sink fractions in separate, properly identified jars for chemical analyses.

16. Clean centrifuge tubes with methanol before running next analysis.

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FLOAT-AND-SINK ANALYSIS OF FINE COAL

Coal Identification ______________________________

Gravity Separation @ ______________________________

Weight of Feed Material:

	Coal + Tube Weight		Tube Weight		Coal Weight
Centrifuge Tube 1	________	-	________	=	________
Centrifuge Tube 2	________	-	________	=	________
Centrifuge Tube 3	________	-	________	=	________
Centrifuge Tube 4	________	-	________	=	________
			TOTAL COAL WEIGHT		________

Weight of Float Fraction:		**Weight of Sink Fraction:**	
Coal + Filter Paper	________	Coal + Filter Paper	________
Filter Paper	________	Filter Paper	________
Float Weight	________	Sink Weight	________

Weight of Float-and-Sink Fractions:

	Weight	Weight, %
Float	________	________
Sink	________	________
TOTAL	________	100.0%

Date: ______________

Analyst: ______________

BCR Form 135

F-2

STAGE GRINDING OF FINE COAL TO A REQUIRED SIZE CONSIST

June 15, 1967

SCOPE:

This method describes the technique of stage grinding a sample of fine coal (minus 14 mesh, U.S. Sieve Series) to a predetermined size consist based on fixed carbon and fixed carbon and calorific value. (See Table 1)

TABLE 1. REQUIRED PULVERIZED COAL FINENESS -- PERCENT THROUGH NO. 200 SIEVE

Fuel Classification (Dry Basis)					
Fixed Carbon			Fixed Carbon Below 69%		
%	%	%			
97.9 to 86	85.9 to 77	76.9 to 69	Btu Above 12,900	Btu From 12,900 to 11,000	Btu Below 11,000
80	75	70	70	65	60

APPARATUS:

Balance with sufficient sensitivity to weigh to nearest 0.1 g.
Holmes Pulverizer (Model 3B) with 60 mesh screen insert
Mortar and pestle
U.S. Sieves: 297-micron (No. 50)
149-micron (No. 100)
74-micron (No. 200)
Sieve pan and sieve cover

PROCEDURE:

1. Record all data on Data Sheet (sample attached)
2. From the proximate analysis, use Table 1 to determine the required weight percent of coal which must pass through the 200 mesh screen.
3. Tare sieve pan and record weight. Pour coal sample into pan and weigh. The weight of sieve pan plus coal minus the weight of sieve pan is the coal sample weight. From the weight of the coal sample determine the weight of coal needed to obtain the required weight percent of coal which must pass the 200 mesh screen.
4. Tare sieves and record weights.
5. Pour coal sample from sieve pan into Holmes pulverizer to reduce sample to minus 60 mesh.
6. Assemble bank of sieves, using tared sieves in descending order of mesh size openings (that is, No. 50, No. 100, No. 200) and placing tared sieve pan on bottom of bank.
7. Pour the minus 60 mesh pulverizer product into the bank of sieves, attach sieve cover, and sieve using the hand-sieving method.
8. After one minute of hand-sieving, brush bottom of 200 mesh sieve into sieve pan and weigh.
9. Reassemble and hand-sieve for one minute, brush bottom of 200 mesh sieve into sieve pan and weigh. Repeat the procedure until the weight of coal passing through the 200 mesh sieve does not exceed 0.1 g.
10. If the weight of the minus 200 mesh coal exceeds the required weight, the stage grinding procedure must be repeated on the representative reserve cut of the coal sample using the mortar and pestle to accomplish pulverization. If more minus 200 mesh coal is needed to obtain the required weight, this can be accomplished by mortar and pestle using the coal retained on the 50 mesh sieve and, if necessary, the coal retained on the 100 mesh sieve. Steps 8 and 9 are repeated until the required minus 200 mesh coal weight is obtained to within ± 1.0 percent.
11. Weigh tared sieves, record weights to determine weights of retained coal and calculate to weight percent.

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STAGE GRINDING OF FINE COAL TO A REQUIRED SIZE CONSIST

Coal Identification ______________________________

Fixed Carbon ____________________ Btu ____________________

Required Percent Through No. 200 Sieve ____________________

Sieve Pan +
Coal Sample Weight __________

Sieve Pan Weight __________

Coal Sample Weight __________ X % Required = __________

Required Weight of
Minus 200 Mesh Coal

Sieve No.	Coal + Tare Weight		Tare Weight		Weight of Coal Retained	Weight % of Coal Retained
50	______	-	______	=	______	______
100	______	-	______	=	______	______
200	______	-	______	=	______	______
PAN	______	-	______	=	______	______
	TOTAL WEIGHT OF COAL =					100.0%

Date: ____________________

Analyst: ____________________

BCR Form 136

APPENDIX G

CHEMICAL ANALYSIS OF COAL AND COAL REFUSE MATERIALS

Most coal laboratories probably rely on the methods for determining forms of sulfur in coal which are contained in ASTM Standards, Part 19, entitled "Gaseous Fuel, Coal, and Coke."

Briefly, the determination of sulfur forms according to ASTM procedures is as follows: Total sulfur is determined by fluxing a -60M coal sample with Eschka's mixture at 800 C to convert all sulfur to sulfate. The sulfur is precipitated as barium sulfate and is ignited at 925 C. Total sulfur concentration is obtained by applying the appropriate gravimetric factor.

Sulfate sulfur and non-pyritic iron are determined by extraction of the coal sample with hot hydrochloric acid. Iron is removed from the extract by oxidation and then precipitation with ammonium hydroxide. The concentration of non-pyritic iron is determined by dichromate titration. The sulfur is precipitated as barium sulfate, and is then ignited and weighed.

Pyritic sulfur is determined by extraction of the coal sample with nitric acid followed by titrimetric determination of total iron in the extract. Non-pyritic iron is subtracted from total iron, and the resultant value is multiplied by the appropriate factor to obtain pyritic sulfur.

Organic sulfur is determined by subtracting the sum of sulfate sulfur and pyritic sulfur from total sulfur.

The BCR method for determining sulfate sulfur is essentially the same as that prescribed by ASTM. We have found it necessary, however, to depart from the normal ASTM methods for determination of total sulfur and pyritic sulfur.

Our method for total sulfur is the same as the ASTM method to the point of filtering the barium sulfate precipitate. The samples which we analyze, however, may contain total sulfur ranging from less than 1 percent to approximately 40 or 50 percent by weight. Obviously the latter case requires handling abnormally large quantities of barium sulfate precipitate. The resultant analytical data may therefore be imprecise and inaccurate because handling procedures are subject to variance in operator technique. There also exists the possibility of reaction between filter paper and barium sulfate precipitate during final ignition.

In order to help solve the above problems we have developed a vacuum filtration system which can accommodate 12 filter crucibles.

Among the advantages of this device are significant reduction in filtration time; more rapid ignition of precipitate, as well as ignition at lower temperature (750 C). Moreover, we can achieve excellent precision with this device because it is easier for any operator to wash the precipitate thoroughly.

The ASTM procedure for determining pyritic sulfur as described previously involves nitric acid extraction of the coal sample. We feel that this procedure is not satisfactory because a portion of the pyrites in some bituminous coals will not be extracted. This is due mainly to inadequate penetration of the coal material by the nitric acid and to varying modes of occurrence of pyrite (for example, micro pyrites, globules, layers, etc.). Reduction of the sample to a finer size consist helps alleviate these problems but it is not the absolute answer.

In order to minimize this problem, we extract total iron from the sample by refluxing the ash from proximate analysis with hydrochloric acid. The iron concentration is then determined by dichromate titration. We feel that this procedure yields results for total iron which are more accurate than those obtained by the nitric acid extraction of coal.

Non-pyritic iron values may be in error if this form of iron is not completely extracted from the coal by hot hydrochloric acid. This could occur, for example, if the size consist of the sample is too coarse or if the sample contains compounds such as iron silicates.

Pyritic sulfur values based on the determination of pyritic iron may be in error due to replacement of pyrites by iron oxides, thus increasing the iron/sulfur ratio in the sample. Another possibility is that the iron/sulfur ratio in pyrite may not always be 1:2.

A possible solution to these problems would be to determine organic sulfur by Eschka fusion of the residue from a nitric acid extract of coal, and then obtain pyritic sulfur by difference. Problems with this procedure may arise because organic sulfur can be attacked by nitric acid. On the other hand, portions of the pyritic sulfur might not be extracted.

We have also experienced on occasion some difficulty determining iron by dichromate titration. Interferences in the oxidation-reduction process are probably due to species other than iron consuming the oxidizing agent; however, we have not been able to elucidate much regarding this possibility.

One of the more expedient solutions to the interference problem is to oxidize and precipitate the iron as ferric hydroxide prior to the dichromate titration. Another, and perhaps better, approach would be to determine iron by more selective methods such as emission spectroscopy or atomic absorption.

During the course of experimental work on the project, it was deemed necessary to determine the carbon content of high sulfur refuse materials as well as to quantitatively determine the sulfur forms. The primary purpose was to determine purity of refuse samples with respect to percentage pyrite and percentage carbon.

The first method which was developed involved combustion of the sample in a stream of oxygen, conversion of sulfur dioxide to sulfur trioxide and finally to sulfuric acid. Carbon dioxide was absorbed in a suitable reagent and the percentage carbon obtained by applying a gravimetric factor.

Several problems were encountered in the first method. The procedure was very time consuming and very complicated. It was also difficult to remove all the sulfuric acid aerosol created by the high sulfur content of the samples. The use of chromic acid and chromic-sulfuric acid mixtures also caused the procedure to be inherently dangerous to personnel.

A second method, being developed at the present time, involves combustion of the sample in a stream of oxygen; collection of all product gases, with subsequent analysis for all carbon-containing compounds by gas chromatographic methods.

Primary advantages of the second method over the first are that it is faster and more accurate; the carbon is all converted to carbon dioxide (at least this has been our experience so far), and the sulfuric acid aerosol problem has been eliminated. The procedure is therefore less involved, and elimination of reagents such as chromic and sulfuric acids renders the method less dangerous to personnel.

We believe it is appropriate at this point to suggest some changes in methods for determining sulfur forms in coal and coal refuse materials.

One analytical scheme which merits further testing would involve initially determining sulfur forms and percent carbon in the original coal sample. These values can be determined quite accurately. Refuse material (from the original coal) would be analyzed for total sulfur, sulfate sulfur, and carbon. Concentration of organic sulfur in the refuse fraction would then be calculated by the following formula:

$$\begin{matrix}\text{Percent}\\ \text{Organic Sulfur}\\ \text{(fraction)}\end{matrix} = \begin{matrix}\text{Percent}\\ \text{Organic Sulfur}\\ \text{(original sample)}\end{matrix} \times \frac{\text{Percent Carbon (fraction)}}{\text{Percent Carbon (original sample)}}$$

This formula implicity assumes that the proportion, organic sulfur to carbon in the refuse material, is the same as that in the original coal.

We feel that these procedures would give results which are more accurate than procedures now utilized, especially dealing primarily with coal refuse material containing high percentage sulfur.

Many problems which arise during analysis of coal refuse materials may be traced to improper procedures for analytical sample preparation and handling rather than to analytical methods. As an illustration, samples which are either dry or which contain large amounts of moisture should be equilibrated to laboratory conditions in order to minimize gain or loss of moisture over time.

The high specific gravity of refuse samples, particularly the pyrite portion, may also cause sampling problems in the laboratory. A refuse sample may be stratified very easily by simply tapping the sample container on a bench top; therefore, extra care must be taken during mixing and when removing the individual portion for analysis.

Most refuse samples should also be pulverized to a finer topsize (-100M) than normal analytical coal samples (-60M) in order to improve precision and accuracy of analytical results. It is also advisable, when working with small quantities of sample, to hand grind rather than to pulverize mechanically in order to avoid significant loss of sample.

STANDARD TITLE PAGE FOR TECHNICAL REPORTS	**1. Report No.** APTD-0579	**2. Govt. Accession No.**	**3. Recipient's Catalog No.**

4. Title and Subtitle

An Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur From Fine Coal

5. Report Date

6. Performing Organization Code

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Bituminous Coal Research, Inc.

10. Project/Task/Work Unit No.

11. Contract/Grant No.

PH 86-67-139

12. Sponsoring Agency Name and Address

National Air Pollution Control Administration Technical Center
411 West Chapel Hill Street
Durham, North Carolina 27701

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstracts The objective was to extend washability data to finer sizes of coal, and to evaluate coal cleaning methods and techniques for removing pyritic sulfur from the fine-sized coal. Two sizes were of interest in the washability studies. The 30 mesh x 0 size was the lower limit in sizing that would contain a size range of pyrite typical of a utility pulverizer's recycle load. It is this recycle material that can possibly be removed from the utility pulverizer, wet-cleaned to remove the pyrite, and the clean dewatered coal reinjected into the feed to the pulverizer without thermal drying. The second size range of interest was each coal's "as fired," or p.c. grind. It is at this stage of pulverization that maximum pyrite liberation occurs, insofar as the coal's present utilization is concerned. The evaluation of coal cleaning methods and techniques was limited to 30 mesh x 0, grind. The seventy coals tested came from three geographical areas: Western Pennsylvania, Eastern Ohio, and Illinois. Maximum pyritic sulfur reduction obtained at the 30 mesh x 0 size was 93.7 percent with an Ohio No. 6 coal; the minimum pyritic sulfur reduction obtained was 51.2 percent with an Illinois No. 6 coal. At the p.c. grind, 95.0 percent of the pyritic sulfur was removable from a Pennsylvania Lower Freeport coal while

(continued on back of page)

17. Key Words and Document Analysis. (a). Descriptors

- Air pollution
- Coal preparation
- Cleaning
- Pyrite
- Washing
- Fines
- Fineness
- Pulverized fuels
- Coal
- Desulfurization
- Concentrating
- Hydrocyclones
- Spirals (concentrators)
- Concentrators
- Classifiers
- Evaluation

17b. Identifiers/Open-Ended Terms

- Concentrating tables
- Concentrating spirals
- Compound water cyclones
- Air classification

17c. COSATI Field/Group 13/02, 21/04, 10/02

18. Distribution Statement	**19. Security Class (This Report)** UNCLASSIFIED	**21. No. of Pages** 286
	20. Security Class. (This Page) UNCLASSIFIED	**22. Price**

FORM NBS-867(1-70)

16. Abstracts (Continued)

the minimum percentage of pyritic sulfur removal was 54.5 percent with a Pennsylvania Middle Kittanning coal which had a very low R.O.M. pyritic sulfur content. Total sulfur reductions covered a much wider range since the percentage of organic sulfur, which was not removable, quite significantly affected the percent reduction. If pyrite removal is to stand on its own merit as a method of reducing sulfur dioxide emissions, a high percentage of total sulfur reduction must be obtained at the selected size for processing. If limestone or dolomite injection is to be considered as a supplement to the removal of pyrite from the coal, the percentage of pyritic sulfur reduction must be fairly high and the effect of a high organic sulfur content on poor total sulfur reduction becomes less significant. The results of the coal cleaning tests with the concentrating table were, in general, excellent. The results obtained with the compound water cyclone and concentrating spiral were not encouraging when judged purely on the separations obtained. A wide range in sulfur reduction was obtained in the Majac air classification tests. This was expected, since the coals were not selected on their predicted ease of separation. Total sulfur reductions of 40 percent could be significant if the cost of the process per ton of coal is low.